

Popular Science

FOUNDED **MONTHLY** 1872





This symbol
of quality
is your pro-
tection

Radiola Grand and Mahog-
any Stand with "B" bat-
teries and 4 Radiotron WD-
11 dry cell vacuum tubes
\$350.00

Radiola Grand

WITH the Radiola Grand, radio takes on new mean-
ing. The simplicity of tuning in
—just a knob or two to turn. The
big distances it covers—picking
up far-away stations with volume
enough to fill a room. The per-
fection of tone with which the
loudspeaker—carefully built in
like the horn of a fine phono-
graph—gives forth the music and
speech. All this—combined in a
cabinet of skillful workmanship
and tasteful design—places radio
in the home where beauty counts
—and performance.

Points to Note:

All the batteries—dry cells—are
hidden away inside.

You can regulate the volume of
sound by a control that governs the
loudspeaker.

For long distance, plug in the head-
phones. Coast to coast reception
is no unusual record for Radiola
Grand!

Famous for true reception, undis-
torted. For keen sensitivity. And
for beauty.

"There's a Radiola for every purse"

as the nearest Radio or Electrical Store

Radio Corporation of America

Sales Department
253 Broadway
New York

District Sales Offices
10 So. LaSalle Street
Chicago, Illinois
433 California Street
San Francisco, California

RADIO CORPORATION OF AMERICA
Dept. 2080, Address office nearest you.
Please send me your free Radio Booklet.

Name _____

Street Address _____

City _____ R. F. D. _____

State _____

Radiola

U.S. PAT. OFF.

See Here!

You can make
\$75 to \$125
a week!

NOW You Can Learn AT HOME!



Your Name HERE!

A business of your own, paying \$3,000 to \$10,000 a year in profits! Cooke-trained Experts have gone into business with little or no capital and have found their future and their fortune repairing Automobiles, Trucks, Tractors, Gas Engines. You can, too!



B. W. COOKE
President Cooke
Auto School
greatest insti-
tution of its kind
in the world.

At last! you can become an auto, truck and tractor expert right in your own home with our practical, "Job-Way" training. If you like machinery, if you want to get ahead, here is the quickest road to BIG PAY! In what other way can you trade your spare time right at home for TRAINING that will prepare you to go into business or take your choice of a hundred jobs paying \$75 to \$125 a Week! Good jobs everywhere! In garages, repair shops, service-stations, factories. As Salesman, demonstrators, electrical experts, Master Mechanics. In Battery stations, Vulcanizing Shops, Welding plants or in business for yourself. Salaries sky-high, easy hours, and opportunities for a business of your own all around you! Man alive! You cannot afford to hesitate a minute!

Learn Auto Mechanics Electricity, Tires, Welding, Battery

Now 15 million autos, trucks and tractors crowding the cities, highways and farms, 15,000,000 electrical systems to maintain and repair, 50 million tires to replace and repair, 15 million batteries to test and service, 15 million autos, trucks and tractors to keep going! Do you realize that COOKE "JOB-WAY" training prepares you right at home for the opportunity—that when you're EXPERT you don't need "luck" or an "opportunity"—they're right here NOW waiting for you to start and finish!



Learn to do Any Job!

The Cooke "JOB-WAY" trained man gets the big money, because no job is too hard for him! He finds the trouble instantly and can repair it quickly.

Be an Auto-Tractor-EXPERT!

Start NOW!

Men Wanted!

I train you to hold down these big-pay Jobs:

MASTER MECHANIC	\$1000 to \$18000
ELECTRICAL EXPERT	\$1600 up
GARAGE MANAGER	\$1000 up
TRACTOR ENGINEER	\$2400 up
SALESMAN	\$3000 to \$12000
EXPERT WELDER	\$2400 up
BATTERY EXPERT	\$2400 up

LEARN WITH TOOLS



\$1850 Repair Kit FREE

No books or useless theory in my home study "JOB-WAY" Course. This \$18.50 repair kit only one of many inducements offered to get you started on the road to success NOW! Mail coupon for complete information, learn how you can MAKE MONEY almost from the start with this outfit.

RADIO COURSE FREE! This Month

Only one of the many surprises waiting for the man who has "promised" enough to write for my big offer right away! Without one cent of cost, I am giving away a limited number of these \$45 courses. Why not get one? SUCCESS Coupon entitles you to this money-making course Free!

I'll help you start and help you finish. Inducements you cannot resist, RIGHT NOW to ambitious men; terms within reach of everybody! Free Employment Service to help you get the job you want at top pay! Many extras, but not one penny extra for anything. Find out how easy I have made it for you to SUCCEED thru my SUCCESS coupon.

Mail Coupon TODAY!

B. W. COOKE, President
Cooke Auto School
Dept. 106,
500 S. Throop St., Chicago

**COOKE
AUTO
SCHOOL**

SUCCESS COUPON

B. W. COOKE, President
Cooke Auto School, Dept. 106, 500 S. Throop St., Chicago
Please send me Free Book and complete information about your Home Study Course. I am mailing this promptly to secure FREE RADIO COURSE, FREE REPAIR KIT and the reduced prices and special terms you offer now. Of course, I am not obligating myself in any way.

Name
S. N. or R. F. D.
City State

Three new Victrola models



Victrola No. 400
Mahogany, \$250 Electric, \$290



Victrola No. 405
Walnut, \$250 Electric, \$290



Victrola No. 410
Mahogany, \$300 Electric, \$340

The three new Victrola models illustrated herewith incorporate Victrola musical quality in cabinets reflecting all the skill of the master designers of other generations—a perfect combination of art and utility with moderate cost, resulting from our unequalled facilities and long experience.

Fully equipped with albums, Victrola No. 2 sound-box, new improved Victor tapering tone-arm and goose-neck sound-box tube, full-floating amplifier, speed indicator and the simple, reliable Victor motor.

Built entirely in the Victor factories, which are the largest devoted entirely to the production of one musical product.

In buying a talking-machine consider that you must choose the Victrola or something you hope will do as well and remember that the Victrola—the standard by which all are judged—costs no more.

A selected list of Victor Records illustrating Victor quality

Lucia—Sextet	Galli-Curci, Egner, Caruso,		
	de Luca, Journet, Bada	95212	\$3.50
Berceuse from Jocelyn	McCormack and Kreisler	89186	2.00
Elegie—Mélodie	Caruso and Elman	89066	2.00
Song of the Volga Boatmen	Chaliapin	88663	1.75
Whispering Hope	Gluck and Homer	87524	1.50
Ave Maria (Schubert)	Heifetz	74563	1.75
Minuet in G (Paderewski)	Paderewski	74533	1.75
La Capinera (The Wren)	Galli-Curci	64792	1.25
Traviata—Prelude	Victor Symphony Orchestra	35717	1.25
Waltz of the Flowers			
National Emblem March	U. S. Marine Band	18498	.75
Lights Out March	Arthur Pryor's Band		



Victrola

Look under the lid and on the labels for these Victor trade-marks
Victor Talking Machine Company, Camden, N. J.

These Bas-Relief Lincoln Book-Ends are of a heavy beautiful, bronzed metal; they would sell at any store for at least \$1.00, in most stores for \$1.25 or \$1.50. Read below how you may obtain a pair for nothing.



Free—this pair of Lincoln Bas-Relief Book-Ends an offer that can never be made again

An amazingly liberal introductory offer on a new set of thirty world's masterpieces. Read below why it is made.

YOU have heard of Little Leather Library books. There are few good homes in the country where these beautiful little volumes cannot be found. Over 20,000,000 were sold prior to 1923. Now, a new set of thirty of the world's greatest masterpieces has been published in this edition at a price of only \$2.98 for all thirty volumes.

From past experience the publishers know that, as soon as this new set is fairly well distributed in representative American homes, it will become as universally popular as their previous books. To have a few thousand sets distributed quickly, this unprecedented offer is made to readers of *Popular Science Monthly*.

Can you afford not to take advantage of it? Here are thirty beautifully bound volumes, books that every intelligent person wants to own, sold at the amazingly low price of only \$2.98 for all thirty; and, in addition, this handsome pair of bronzed metal Lincoln Book-Ends, worth from \$1.00 to \$1.50, but given to you free.

Thirty Books for the Price of One

The books themselves are works that no person, mindful of his friends, would care to confess he is not familiar with. They are complete masterpieces, in some cases more than one, of such immortal authors as:

Barrie	Allen	Dumas
Kipling	Balzac	Emerson
Shaw	Browning	Whitman

\$5000.00 in Cash Prizes

TO FURTHER acquaint the public with the contents of these wonderful masterpieces, a unique prize contest has been inaugurated and is now going on. There are 47 cash prizes, from \$2,000 down. Complete details, if desired, will be mailed free upon request. The judges are Charles Dana Gibson, artist and president of *Life*; Professor Albert Bushnell Hart, Harvard University; Wm. D. Howells, editor of *The Mentor*.

Contest Closes Oct. 31, 1923

E. Browning	Moore	Whittier
Poe	Tennyson	Turgenev
Irving	Plato	Longfellow
Ibsen	Wilde	Dante
Shakespeare	Masterlinck	Elbert Hubbard
Lamb	Yeats	

Is this offer too good to be true?

There are over 3000 pages in this set of books. They are in a very convenient pocket size, so that you can read them, not only at home, but in idle moments while traveling. The paper is equal in quality to that used in the ordinary \$2.00 volume; the type is clear and easy to read; the binding is NOT paper, NOT cardboard, but a beautiful limp de luxe material, more durable than leather, and so handsomely embossed that even experts have mistaken it for hand-tooled leather.

How can thirty such books be sold for only \$2.98? How is it possible? The fact is that the chief difficulty the publishers have

experienced is the belief that such an offer is "too good to be true"—that there must be a "catch" somewhere. Even when people see the books they write and exclaim: "How can you do it?" "It is the most amazing bargain of my life." "Each volume, I would have guessed, was worth at least \$2.00." And so on.

It is no secret, however, how this extraordinary value can be given. These books are printed in editions of at least one million copies at a time. Quantity production—and eliminating middlemen's profits—that is the answer.

Send no money—sent for free examination

Sooner or later, you will want to obtain and read—or re-read, these great masterpieces of literature. Why, then, not order the set at once, when you can get this pair of Lincoln book-ends free, and while the \$5000 Prize Contest is going on?

If you question the unprecedented value, remember that these entire thirty volumes will be sent for examination at our risk. Do not send any money. Simply mail the coupon below. When the package arrives give the postman only \$2.98, plus the few pennies for delivery charges. Then examine the set at your leisure. If you do not agree that this is one of the most wonderful bargains of your life, send the set back any time within thirty days and your money will instantly be refunded. Can a fairer offer be made? References: *Popular Science Monthly* or Manufacturers Trust Co. of New York.

Little Leather Library Corporation

Dept. 6610

354 Fourth Avenue, New York, N. Y.



Little
Leather
Library
Corp'n,
Dept. 6610,
354 Fourth Ave.,
New York City

Please send me the new set of 30 volumes of the Little Leather Library, and a pair of Lincoln Bas-Relief Book-Ends free. I will give the postman \$2.98 plus the few pennies delivery charges upon delivery. It is understood, however, that this is not to be considered as a purchase, I reserve the right to return them within thirty days and you agreed to return my money.

Name.....

Address.....

City..... State.....

POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

October, 1923; Vol. 103, No. 4
25 cents a Copy; \$2.50 a Year



Published in New York City at
225 West Thirty-ninth Street

SCIENCE and thought are inseparable twins. Each new discovery, each new invention, has the magic power of thought behind it. But an even more wonderful and more potent force is forethought. Forethought drives science forward to new achievements. It is forethought that permits the scientist to peer into the future, to look over the edge of the present and to see the needs of coming generations.

JULES VERNE was not a scientist, but he possessed the priceless gift of forethought. Fifty-four years ago, in "Twenty Thousand Leagues under the Sea," he fabricated a vivid picture of the modern submarine. Twenty-nine years later he prophesied that the United States would "have mighty navies, not only on the bosom of the Atlantic and Pacific, but in the upper air, and beneath the waters of the surface."

QUITE as amazing as these predictions, both of which have been fulfilled, is the prophecy of Admiral Moffett, chief of aviation, United States Navy, on page 30 of this issue. He pictures an airship 900 feet long, equal to the *Leviathan* in size, carrying a fleet of airplanes as ocean steamers now carry lifeboats, manned by a regiment of men and capable of encircling the globe in a couple of days. When such monsters of the air are practicable, they will draw the ends of the earth closer together. Its peoples will be united in closer understanding, and we may take week-end trips to foreign lands as we now drive into the country in our automobiles.

FORETHOUGHT and courage combined in one man produced a scientist who has been called the "supreme benefactor of the human race"—Louis Pasteur. The dramatic life story of this great Frenchman is told on page 57. It was Pasteur who discovered germs, who found a way of destroying them, who

blazed the path on which all modern surgery and medicine walks. He was jeered at, called an ignorant charlatan. But he persevered and lived to see the scoffers at his feet. Millions are alive today who would be dead but for Pasteur. The whole world is this year observing the centenary of his birth and blessing his memory.

MOST of us, far from exercising forethought, do not use our brains enough even in the ordinary processes of thought. At least, that is the opinion which Dr. James J. Walsh, noted psychologist, expresses in a remarkable article on "Memory" on page 36. Doctor Walsh shows how, by the use of a simple "daily dozen" for the mind, all of us may strengthen our memories and make ourselves more efficient in carrying on the ordinary tasks of life.

FORETHOUGHT of the sort that carries even science into the future is being displayed today by Capt. Donald MacMillan, famous Polar explorer, who has sailed into the illimitable spaces of the Far North. He plans to plant landmarks on the glaciers so scientists of the future may know exactly when the next Age of Ice is coming. In a thrilling article on page 48 Captain MacMillan tells how he will carry out this extraordinary scientific work and how he will attempt for the first time to make radio waves penetrate through the Northern Lights, broadcasting messages to us from the frozen Arctic.

THE forethought of oil men and automobile engineers has furnished us with protection from the odd but fearful fire hazard that tiny sparks of static electricity may bring to motorists. How this is done is told on page 27. In fact, every article published in this number tells of

something made possible by the magic power of forethought.

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POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription in United States, its possessions, and Canada \$2.50; foreign countries, \$3.
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H. J. Fisher, President; R. C. Wilson, Vice-President
O. B. Capin, Secretary and Treasurer

Discovers New Way To Teach Salesmanship in 20 Weeks!



After fifteen years an amazing new method has been formulated whereby it is possible for any ambitious man to get into this fascinating and best paid of all professions in 20 weeks.

By J. E. Greenlade

HERE is the biggest discovery that has been made since men first began to prepare themselves for selling positions through spare time study at home.

After fifteen years intensive study the National Demonstration Method has been perfected—and men can now step into a selling position inside of twenty weeks—with years of practical experience *in their heads*.

This amazing discovery may well enable you to call yourself a MASTER salesman at the very beginning of your actual selling career. For, after all, MASTER salesmanship is nothing more than a knowledge of what to do in *every* situation—and this is what you will have learned from this new method.

For the sales problems which every salesman meets during his experience have all been charted and the most masterful way to handle each of these 64 conditions is shown you. In addition to the National Demonstration Method you will get the same wonderful groundwork of selling and business knowledge which has been responsible for the success of thousands in the past.

How Well It Works

This is the method that enabled Wagner—a fireman—without any previous business training or without any fluency as a talker—to exchange his shovel for a sample case and to exchange his poorly paid hard-working situation for the most fascinating of all professions; with a salary of \$7,000 a year.

After 3 months' study, in his spare time, at home, it enabled H. D. Miller, of Chicago, a stenographer, to step out of a \$100 a month job right into a \$100 a week position.

And I could cite hundreds of other instances, where these remarkable changes from poorly paid positions into this high salaried profession have

been made after from 12 to 20 weeks of this easy, fascinating study. Men in every walk of life have made this change—farmers, laborers, mechanics, bookkeepers, ministers—and even physicians and lawyers have found that Salesmanship paid such large rewards and could be learned so quickly by this new method that they have preferred to ignore the years they spent in reading law or studying medicine and have become master salesmen.

What This Method Means to You

Are you tired of doing routine work which wears a man out long before his time? Are you tired of the daily monotonous grind at a salary that makes it impossible to get any of life's luxuries whatever? Are you tired of the uncertainty of permanence which is always a feature of the average clerical position? Then why not decide to enter the profession where the earnings are high—where the constant demand for good salesmen insure that one may never fear loss of a position and where the work is so fascinating that it is like playing an interesting game and getting paid for it?

Get Free Book on Selling

This amazing new demonstrating method—which gives you years of practical experience in less than 5 months—is all explained in an interesting book called "Modern Salesmanship." It also explains the wonderful opportunities which exist in the selling field and tells all about our free employment service. It should be in the hands of every ambitious man who wishes to insure that his future will be a bright and prosperous one. It will be sent free and without obligation. Mail attached coupon today.

National Salesmen's Training Ass'n.

Dept. 15-R, Chicago, Illinois

National Salesmen's Training Ass'n.

Dept. 15-R, Chicago, Illinois

Send me free book "Modern Salesmanship" which explains the New Demonstration Method and shows how I can become a Master Salesman. This does not obligate me in any way.

Name.....

Address.....

City..... State.....

Age..... Occupation.....

EMPLOYERS

Are invited to write in the Employment Dept. of the N. S. T. A. No charge for this service to you or our members. Employers are also cordially invited to request details about the N. S. T. A. Group Plan of instruction for entire sales forces. Synopsis and chart sent without obligation.

Money Making Opportunities for "Popular Science" Readers



AUTOMOBILES AND ACCESSORIES

PATENTS—Write for free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 188 Ninth, Washington, D. C.

AUTOMOBILE PARTS—Used parts for most any car of half factory list prices. Allen, Brasco, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Ford, Grant, Hudson, Hummer, Oakland, Overland, Oldsmobile, Reo, Studebaker, and many others. Short list of parts wanted. Maxwell Bros., 4100 Olive St., St. Louis, Missouri.

AUTOMOBILE OWNERS, GARAGEMEN, MECHANICS send for free copy America's popular motor magazine. Contains helpful, money-saving articles on repairing, overhauling, lubrication, carburetors, batteries, etc. Automobile Digest, 625 Butler Bldg., Cincinnati.

FORD ACCESSORIES

SPEEDSTER fairs—see "Red-1-Kat" ad, page 114.

WANTED

DETECTIVES—Excellent opportunity. Freehearting work. Experience unnecessary. Particulars free. Write American Detective System, 1944 Broadway, New York.

BE a success. Do you want to know for what reason you are being failed? Do you want a better position? Then write us. Particulars free. National Institute for Vocational Success, 514 McCarthy Bldg., Syracuse, New York.

TYPISTS—Earn \$25-\$100 weekly in spare time copying authors' manuscripts. Write R. J. Corbin, P-1, Tallahassee, Fla., for particulars.

BECOME a ship's officer on passenger and merchant ships. See the world. No enlistment. Remits your health. \$100 to \$150 per month while searching. Write officer in service bureau. E. W. Gossman, Detroit River Bldg., P.O. L. M. Towers, Michigan.

DUPLICATING DEVICES

"MODERN" Duplicators save Time, Labor and Money. Copy Business, Educational, Typewritten or Pencil Letters, Drawings, Maps, Music, Manus, Bids, Notices, Specifications, Maps or anything in one or more colors. Prints are perfect. Special sale on 30 days Free Trial. \$1.25 up. Booklet free. J. V. French-Russell Co., Pittsburgh, Pennsylvania.

STENCIL Duplicators—Two Dollars. More Blue Letter, Three-dty. Prints Typewritten—Handwritten. On Approval. Primes Specialty Co., St. Primes, Pa.

LABORATORY AND CHEMICAL

EXPERIMENTERS. Complete supplies for the chemical laboratory. Catalogue free. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

YOUR chemical problem solved and working process furnished for five dollars. Write to: W. Swedman Richards, Consulting Chemist, Box 1462, Boston, Mass.

LABORATORY apparatus, reagents, scientific books for sale. For particulars address: P. O. Box 66, Bailey Park, Pa.

TRADE SCHOOLS

EARN more money—Learn sign painting, scenic painting, showcard writing, auto painting, paper hanging, decorating, graining, moulting, at Chicago or at your home. Chicago Painting School, 137 West Austin Avenue, Chicago.

PRACTICAL courses in photo-engraving are offered by Wentworth Institute, in co-operation with national and local associations of engravers, at its School of Graphic Arts. The instruction covers work of all the divisions in the industry, and important related subjects. The day course starts on September 24, 1923, the evening course starts on October 1, 1923. Entrance interviews for the day course will be held on September 18 and 19, 1923, at 8.30 A. M., for the evening course on September 21 and 22, 1923, at 7.30 P. M. For particulars write to the Wentworth Institute, Boston 17, Mass.

PAINT Automobiles, Trim Automobiles. Receive a certified Electrician. We do you for a big money job. Make you an expert, able to step right into a position paying \$45 to \$100 per week. We secure you a job while training that more than returns tuition costs and expenses. Come to Detroit, the Automobile Hub; the World's wonder City. Write today. Standard Trade Schools, 415 Woodward Avenue, Detroit, Mich.

DOGS

AIREDALERS that I breed people appreciate. Dr. Kest, Danbury, Conn.

DOG REMEDIES

BACOL. A scientific vermifuge. Never failed to get all worms, 75c. Carbon Tetrachloride capsules, 50c. Send postal for literature. Bacol, 7815 90th Ed., Woodhaven, L. I.

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What advertisement of "Money Making Opportunities" in this issue interests you most—and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize.....\$10.00
Second Prize.....5.00
Third Prize.....3.00
And 7 Prizes
of \$1.00 each.....7.00

First read every one of the "Money Making Opportunity" advertisements on pages 4 to 20. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before October 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the December issue. Address your prize letter to—

Contest Editor
POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City
Last Month's Prize Winners

The first prize of \$10.00 goes to Miss M. W. Mattern, 4403 N. Fourth St., Philadelphia, Pa., for her letter on the advertisement of E. Lancaster, Los Angeles, Calif.

The second prize goes to Gruver Davis, 441 East Wolfe Street, Harrisonburg, Va., for his letter on the advertisement of American Photography Company.

The third prize goes to Mrs. M. G. Bass, McGeehee, Arkansas, for her letter on the advertisement of The Universal Scenario Corp.

The winners of the other seven prizes are:—
J. White, Kingston, Ontario, Canada; Francis B. Gregory, Syracuse, N. Y.; E. N. Moore, Philadelphia, Pa.; A. Jean Lowe, Lakewood, Ohio; I. O. Tucker, Charlestown, Mass.; C. H. Thomas, Kennett Square, Pa.; Isabelle Shaffer, Reno, Nevada.

REAL ESTATE AND FARM LANDS

PEACH-Orange groves. Department S. Suburban Orchard Co., Ocochee, Mississippi.

ARKANSAS Land \$10.00 per acre in tracts five acres or more. Timbered land near oil development. A sound investment with good speculative chances. Write for full details. H. J. McKelton, F & M Building, Fort Worth, Texas.

LETTER SPECIALISTS

MY master sales letters prepared to your order, will show you profitable sales returns. Ad-Expert 312c per, 2731 Warren Avenue, Chicago.

OPTICAL GOODS

ARTIFICIAL eyes. Booklet free. Dwyer Optic, 505 Barclay, Denver, Colorado.

CONSULTING ENGINEERS

STEEL Problems Solved. Practical. E. W. Bellow, Consulting Metallurgist, Wyomissing, Pennsylvania.

Rate 25 Cents a Word. Advertisements intended for the December issue should be received by Oct. 5

AVIATION

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 1740, 3861 Michigan Ave., Chicago, Illinois.

PROPELLERS for airplane propulsion, 5-foot diameter, \$12.50. 6-foot for Ford, \$15. Others in proportion. Motorcycle Supply Company, 1501 Ford Ave., St. Paul, Minn. Crawford Motor and Automobile, Long Beach, Calif.

MOTORCYCLES, BICYCLES, SUPPLIES

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Motor Co., Dept. 2, Calumet, Ind., Kansas.

PARTS for all motorcycles cheap. Hubert Cycle Co., 1922 W. Wacker, Chicago, Illinois.

NEW and Used Parts for all makes. Send for our price. Kingsborough Cycle Co., 1446 North Kingshighway, St. Louis, Missouri.

DEALERS and Riders: Attention! Write for our special Motor cycle racing bulletin. Dealer's bulletin No. 2 and Rider's bulletin No. 12. Motorcycle Farm Mfg. Co., 2000 Wabash Ave., Chicago, Ill.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of model parts and model supplies. Send for catalogue. The Plastic Model Works, Tudor Park, Illinois.

MODEL making and experimental work: modern shop, expert workmen. Manufacturing. Lamson M. & Mfg. Co., 415 W. Jackson, Chicago.

BEFORE ordering your model write for free copy of Modelcraft. R. O. Cline Engineering Co., St. Louis, Mo.

MODEL Making Supplies—2"-4" diameter, equal thin brass tubing for Model Makers, 100-200, per inch. Also chined ends, per pair, 3", 75c; 4", \$1.00. Miniature machine screws, 3/32" up. Pinked Motor Filaments Catalogue, 20c. Buhe Mfg. Co., Dept. C, 3014 W. Woodland Ave., Philadelphia, Pa.

MOTORS, ENGINES, MACHINERY

MOTORS—G. E., H. P., \$15.00; H. P., \$20.00; 1 H. P., \$25.00. Generators, 5 volt, 10 amp., \$15.00; 22 volt, 100 watt, \$20.00. Other sizes, low prices. Motor Specialties Co., Canton, Pa.

SPEED LATHES—Build your own at trifling cost. Big money in wood turning. Detail blueprint No. 851, \$1.00. Jan. 21, Need, Civil Engineer, Salem, Oregon.

RADIO AND SUPPLIES

TESTED radio receiver. One Blinderiken transmitter button mixed with radio set gives amplification and loudspeaking. Free literature. K. Electric Co., 15 Park Row, New York.

1500 MILL vacuum tube receiver \$24.50. Radio, 4110 Market, Philadelphia.

RADIO World. Great national illustrated weekly; 15c copy. All newsmen. Trial sub. \$1.00 seven issues. 1483 Broadway, N. Y.

RADIO generators 500 V 100 Watt \$28.50 each. Battery Chargers \$12.40—High speed motors. Motor-Generators for sale, all sizes. Motor Specialties Co., Canton, Pa.

FORMULAS

FORMULA catalog free. C. A. Loh, Apartment 241, York, Pennsylvania.

NO mistake Auto cleaner and polish. One operation, cleans anything. Positively Guaranteed. Formula, One Dollar. Flandt & Co., Walcottville, Ind.

AMERICAN MADE TOYS

MANUFACTURERS on large scale, also home working wanted to manufacture metal toys and novelties. Millions needed of building blocks, wag tail pigs, wind animals, windmills, Indians, cowboys, baseball players, cannons, toy soldiers, growing roosters, statues of Liberty, miniature castings of capital, bathing girl, souvenir and others. Unlimited possibilities. Guaranteed casting forms furnished manufacturers at cost price from \$5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high price for finished goods. Cash on delivery. Contact orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1693 Boston Road, New York.

More Money Making Opportunities
on pages 4 to 20



Electricity Needs You I WILL TRAIN YOU AT HOME

Stop right here. This is YOUR opportunity! Electricity is calling you, and the Electrical Business is in for a tremendous increase. But it needs more trained men—at big pay. By my Home Study Course in Practical Electricity I can train you for these positions.

FREE!

BIG ELECTRICAL OUTFIT

A fine outfit of Electrical Tools, Instruments, Materials, etc., absolutely FREE to every student. I will also send you FREE and fully Prepaid—Proof Lessons to show you how easily you can learn Electricity and enter this splendid profession by my new revised and original system of Training by Mail.

RADIO COURSE FREE

Special newly-written wireless course worth \$45.00 given away FREE.

Free Use of Laboratory

I have a large splendidly equipped Electrical Laboratory where you can come at any time for special instruction without charge. Several competent assistants—practical engineers—are in charge.

Earn Money While Learning

I give you something you can use now. Early in my Home Study Course I show you how to begin making money in Electricity, and help you get started. No need to wait until the whole course is completed. Hundreds of students have made several times the cost of their course in spare time while learning.

Earn \$70 to \$200 a Week

You've always had a liking for Electricity and a hankering to do electrical jobs. Now is the time to develop that talent; there's big money in it. Even if you don't know anything at all about Electricity you can quickly grasp it by my up-to-date, practical method of teaching. You will find it intensely interesting and highly profitable. I've trained and started hundreds of men in the Electrical business, men who have made big successes. YOU CAN ALSO

BE A BIG PAID Electrical Expert

What are you doing to prepare yourself for a real success? At the rate you are going where will you be in ten years from now? Have you the specialized training that will put you on the road to success? Have you ambition enough to prepare for success, and get it?

You have the ambition and I will give you the training, so get busy. I am offering you success and all that goes with it. Will you take it? I'll make you an ELECTRICAL EXPERT. I will train you as you should be trained. I will give you the benefit of my advice and 20 years of engineering experience and help you in every way to the biggest, possible success.

Valuable Book Free

My Book, "How to Become an Electrical Expert," has started many a man on his way to fortune. I will send a copy free and prepaid to every person answering this advertisement!

Act Now! Good intentions never get you anywhere. It is action, alone, that counts. NOW IS THE TIME TO ACT.

L. L. COOKE, Chief Engineer

CHICAGO ENGINEERING WORKS

2150 LAWRENCE AVENUE

Dept. 37,

Chicago, U. S. A.

CHIEF ENGINEER
COOKE

Chicago Engineering
Works

Dept. 37, 2150 Lawrence Ave.
CHICAGO, ILL.

DEAR SIR: You may send me entirely free and fully prepaid, a copy of your book, "How to Become an Electrical Expert," and particulars about your Home Study Course in Electricity.

Name

Address

City State

The Cooke trained man is the "Big-Pay" man



CARPENTERS AND BUILDERS!

Just available—Audel's Carpenters and Builders Guides—the short cut, professional information you want.

A Guide that keeps you in close touch with your work and shows you how you may increase your earning power.

No need to guess or take chances. Every day you have before you in this set, exact, practical, useful information to help you with your daily work.

JUST OUT!



POCKET SIZE-FLEXIBLE COVERS

\$1 PER MONTH—ENTIRE SET SIXTEEN HUNDRED PAGES TWO TRADE ILLUSTRATIONS

There are thousands of examples of modern construction and building work—new methods, new ideas, proved efficiency plans, short cuts, time saving suggestions, new ways that cover the entire theory and practice of modern carpentry. Every point is

easy to read and understand and clearly illustrated with sketches and forms. Decide for yourself whether they are worth the money to you. Pay only \$1 a month if you like them. Return the Guides if you don't. **USE COUPON NOW!**

HOW To Handle the Job That Puzzles YOU

How to use the different kinds of wood—complete detailed information on nails and screws—how to use the steel square—how to file and set saws—how to make wood joints—how to build furniture—how to make a miter shooting board—how to plumb, and level work—how to lay out work—how to understand

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how to set window frames—how to cut rafters—how to use the set-squares 12, 13, and 17 on the steel square—how to put on wood, fibre and metal shingles—how to hang doors—how to frame windows—how to put on sheathing—how to put on exterior trim—how to do cornice work—how to build stairs—how to lay floors—how to paint,

FREE EXAMINATION

Not a cent to pay until you see the books. No obligation to pay unless you are satisfied. Send coupon now—today and get this fine, helpful new set for Carpenters and Builders. After you have looked them over 3 days send only \$1, then \$1 a month until \$6 is paid—if you want to keep them. Return them if you do not.



THEO. AUDEL & CO., 72 Fifth Avenue, New York City.

Please submit me for approval and free examination—
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Ship at once, prepaid, the 4 numbers. If satisfactory I agree to send you \$1 within five days and to further mail you \$1 monthly until \$6 is paid.

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SEND THIS COUPON ONLY

Pop. Sci. Oct. '21

Money Making Opportunities

ADVERTISING

ADVERTISE in 24 metropolitan dailies, 34 words, \$15.00. Helpful Guide listing 1000 publications, 40 stamps. Words Company, Baltimore Bldg., Chicago.

ADVERTISING rates for magazines and weeklies free. Charles A. Lutz, Apartment 241, York, Pennsylvania.

25 WORDS—355 rural weeklies. \$14.50. Maytag Agency, 41129 Hartford, St. Louis.

PRINTED lists of weeklies and monthlies free. Blammy Day Adv. Agency, Plainfield, N. J.

INCH Display, 100 magazines, three pt. Book, 5400 Alaska, St. Louis.

CONNECTICUT Advertiser! "Home Occupations," read by thousands, brings results. Write for sample copy and ad rates. Home Occupations, Box A, 338 Richards Ave., Dover, N. J.

FOR THE HOME

GRANDFATHER clock works. \$3.00. Build your own case. Instructions free. Make good profits selling your friends. Clock works with chains for old or new cases. Write for full particulars. Clock Co., Newtown, Pennsylvania.

ADDING MACHINES

FREE trial marvelous free adding machine. Add, subtract, multiply, divide, automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. C, Grand Rapids, Mich.

MISCELLANEOUS

MAKE interesting new friends through lady letters. Betty Lee, Inc., 424 Broadway, New York City. Stamp appreciated.

BRITISH girls desire American correspondents. Proposals 10c. Clark, 16 Cambridge St., London, E. W., England.

CREATE international friendships. Free information. Write: "Internationalist," 1034-A West Eighteenth Street, Chicago, Illinois.

EXCHANGE postcards with 25 countries; use our "European" "farm letters." Europe and 10 addresses free. Thousands eager to exchange. Ferguson Press, Jeffersonville, Indiana.

EXCHANGE letters with new acquaintances made through membership in correspondence club. Address P. O. Box 2362, Denver, Colorado.

LOVEBOMBS—Join our club—make acquaintances everywhere. Big illustrated book with descriptions and photos sent in plain wrapper for ten cents. Donahoe Co., Dept. 43, Kansas City, Mo.

JOIN the old reliable card club. Membership 10c. Riverside Club, Dept. 3, Frederick, Md.

HOMOPATHIC and Biochemic preparations sent postpaid to all parts of the world. Manual and booklets free. Holsey Bros. Co., 111 N. Wabash Ave., Chicago, Illinois. Established 1853.

WISH New Friends? Many ladies and gentlemen desire correspondents. Write Good Fellowship Club, Woodhaven, New York. (Stamp.)

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"SEXUAL philosophy," 12c. Clear, specific, authoritative, complete, best, satisfied. Fred H. Kammath, Lawrence, Massachusetts.

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TOBACCO or Snuff Habit cured or no pay. \$1.00 if cured. Remedy sent on trial. Superba Co., N-5, Baltimore, Md.

CIVILIZATION saved by "Right Rule," easy as water's flow. Use Amendment Turin Chances to Order, here—now—forever. Greatest plan of that for that, since man began. William Reed R. 41. N. U. World, Dept. C, Benton Harbor, Mich.

HOROSCOPES

YOUR Horoscope, business, changes, social, matrimonial prospects. Send birthdate and 10 cents (stamp) for remarkable test reading. Zanya, M-212 West 195th Street, New York.

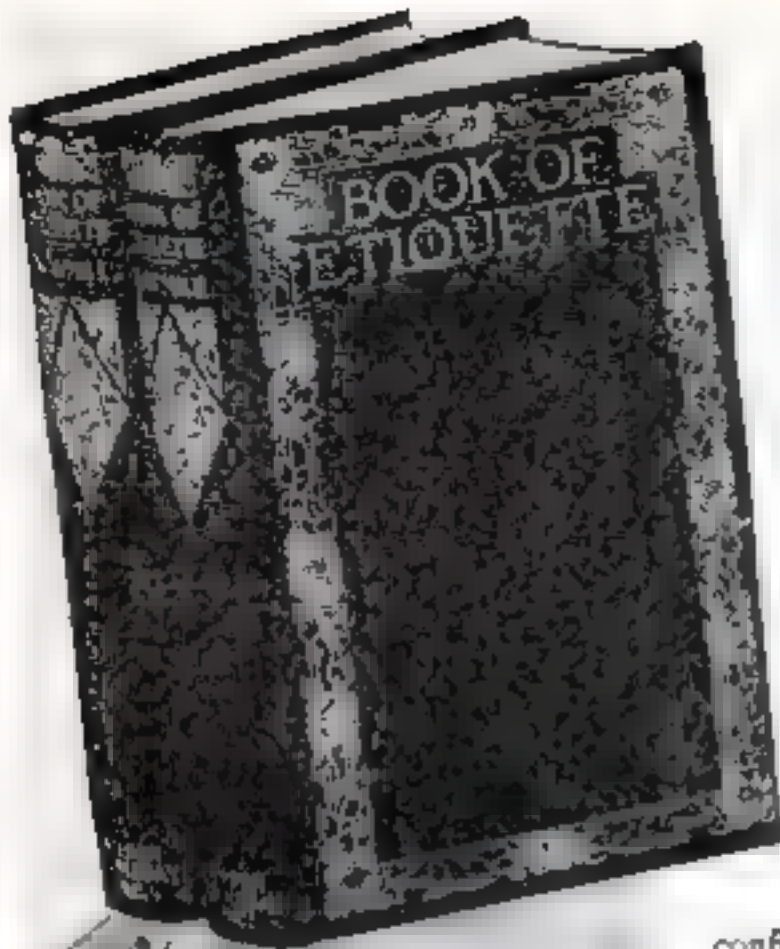
PATENT BUYERS

PATENTS in yours for sale, write for offer. Western Distributors, De Solo, Texas.

FOR SALE

FOR sale, complete set of watchmaker's tools at a bargain. R. Jaegermuth, 5815 Euclid Ave., St. Louis, Missouri.

More Money Making Opportunities on pages 4 to 70



Special Bargain!

The Famous Book of Etiquette

Nearly Half a Million Sold at \$3.50

NOW ONLY \$1.98
For a Very Limited Time

YOU have always wanted this famous two-volume set that solves every social difficulty, that tells you exactly what to do, say, wear, and wear on every occasion. You have always wanted to own the two remarkable books that give poise, ease, dignity—self-confidence.

Here is your opportunity to secure the complete, original, authentic **BOOK OF ETIQUETTE** at the usual publisher's price! Almost 500,000 people have purchased the Book of Etiquette at the regular price of \$3.50. If you act NOW, you can receive the same two authoritative and fascinating volumes for only \$1.98.

This amazing offer is for a short time only. The demand for the Book of Etiquette at this great reduction will probably be so large that the company must reserve the right to withdraw this offer at any time. You are urged to send for your set at once.

Solves Every Social Problem

The Book of Etiquette is admittedly one of the most helpful and authoritative works of its kind. It covers every phase of wedding etiquette, dinner etiquette, dance etiquette, and many paragraphs for the self-conscious debutante, the bachelor, for the business woman, the country hostess. Nothing is forgotten, nothing omitted. The Book of Etiquette will tell you everything you want to know. It will protect you from sudden embarrassments, give you a wonderful new ease and poise of manner.

Wherever possible, in the Book of Etiquette, the origin of customs has been traced to its source. For instance, you find out why rice is thrown after the bride, why a veil is worn, why the engaged girl is given

"Goodbye. I'm Very Glad to Have Met You."

Every day people who are not well-bred make the mistake that he is making. Do you know what it is? Can you point it out?



Are You Ever "Alone" in a Crowd?

Good manners make good marks. The man or woman who is well-bred and well-mannered is always welcome. Always popular. Always happy and at ease.

Do you ever feel alone at a social gathering? Do you ever feel forgotten among strangers?

You will enjoy the Book of Etiquette. And you will find it more useful than you ever dreamed a work of this kind could be.

SEND NO MONEY

Here's your chance—take it! Let us send you the famous two-volume Book of Etiquette at the special offer price.

No money is necessary. Just clip and mail the coupon below to us at once. We will send you the complete, two-volume set of the Book of Etiquette and when it arrives you have the privilege of giving the postman only \$1.98 (plus a few cents postage) for the regular \$3.50 set!

Surely you are not going to let this offer slip by! Clip and mail this coupon NOW while you are thinking about it. Nelson Doubleday, Inc., Dept. 2510, Garden City, New York.

USE THIS SPECIAL COUPON

Nelson Doubleday, Inc., Dept. 2510, Garden City, N. Y.

I accept your special offer. You may send me the complete two-volume set of the Book of Etiquette. When it arrives I will give the postman only \$1.98 (plus a few cents postage) instead of \$3.50, the regular price. I retain the privilege of returning the books any time within 5 days of their receipt, and my money will be refunded at once if I demand it.

Name _____

Address _____



What's Wrong in This Picture?

It is so easy to make embarrassing mistakes in public—so easy to commit blunders that make people misjudge you. Can you find the mistake or mistakes that are made in this picture?

FREE Railroad Fare

Learn Electricity in 3 Months in

CHICAGO

We pay your railroad fare to Chicago—the Electrical Center of the World—from any place in the United States. Grasp this opportunity to see the country at our expense. Don't stick in one spot—travel—get experience. Come to Coyne—the largest electrical school in the country specializing in electrical instruction only. Learn electricity in three months. Fit yourself for a big paying job. Get a complete training so you can make big money as Power Plant Operator, Superintendent, Telephone man, Construction worker, auto, truck or tractor electrician, battery man, radio expert, or you can go into business for yourself as electrical contractor, dealer, auto ignition or battery expert and make from \$3,000 to \$20,000 a year. Hundreds of our graduates today are making big money and you can do the same if you grasp this opportunity—act now.

No books or useless theory. You are trained on \$200,000 worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house-wiring, autos, batteries, radio, switch-boards, power plants—everything to make you an expert ready to step right into a position paying from \$45 to \$100 a week.

WE give you free a course in Radio—the marvel of the age. Constructing, installing and operating. You can build your own radio receiving set.

The complete electrical course gives you practical training in Circuits, House Wiring, D. C., A. C., Armature and Stator Winding, Drafting, Auto, Truck and Tractor Electricity, Battery Building and Repairing and Radio. In addition you receive Free, a Life Membership which enables you to stay as long as you want or come back for further training at any time without charge.

Don't delay a minute—send that coupon right now for

Acknowledgments

Endorsed by Electrical Industry

1300-1314 W Harrison St., Dept. 13-67 Chicago

More Money Making Opportunities
on pages 4 to 20



Only One a Success

—yet all had the same good opportunity!

If someone should tell you that five years from now you would be sunning yourself on a park bench—out of work, out of luck, and convinced that you were a failure—you would probably tell him in no uncertain terms that he was a liar.

And quite probably you would be right.

Every few years, however, the benches are peopled with hundreds and thousands of men in exactly that predicament—and the thing that confounds one is the fact that hardly a man of the lot, five years before, would have believed it possible.

While Others Were Being Displaced This Man Won Promotion

People judge harshly when they say that the men who thus find themselves out of work are not deserving of employment.

There are no finer fellows living than the thousands of men who returned from France to find that there were not places enough to go round. Fortunately, most of these men are now at work. But there was a time—and not so long ago—when they were forced almost to beg for a place.

These men deserved employment, if ever men deserved it—but—business at that time was in such condition that only men who had PROTECTED their jobs by TRAINING—by the development of some special ability to do some special thing—were able to hold their own against depression.

During this period, when men were struggling to get on their feet once more, even LaSalle-trained men did not always have it easy. Demand even for men who have EQUIPPED themselves to perform some special work does not always equal supply.

But—make no mistake—their lot was easier BY FAR than that of the men who could offer merely WILLINGNESS TO WORK.

And in countless instances it was the LASALLE-TRAINED MAN who was retained when others were let go—and in countless instances he won promotion.

There comes to mind, for example, the experience of Sidney Lichtenstein, of Philadelphia, who in August, 1920—just as the

business depression was causing many a concern to shut up shop—enrolled for LaSalle training in Modern Business Correspondence and Practice, and who, in January, 1921, after completing only eight assignments, reported a 40 per cent increase in salary—"when all other employees of the company were being discharged or receiving salary cuts."

"LaSalle," wrote Lichtenstein, "is not only a course for increased efficiency. It is insurance against hard times. As soon as I have completed my present course, you'll find me enrolled for another."

Not particularly dramatic—Lichtenstein's experience. But it was a dramatic experience for him. It is merely TYPICAL.

Secure In Their Jobs and Rapidly Advancing

Times are beginning now. There is plenty of work for the men who have trained. And the test is highly definite. It is the man who has completed his training who is desired. It is the man who has the special ability to do some special thing. It is the man who has the special ability to do some special thing. It is the man who has the special ability to do some special thing.

If you belong to the great army of the unemployed—and are content STAY in those ranks—LaSalle can do very little for you.

If on the other hand you are in earnest to GET AHEAD—LaSalle will find every agency in such statement as the following. It is the trained men who are using their evening hours for advancement.

"The knowledge I secured from your Higher Arithmetic course, and the practical application of your instruction have enabled me to secure a position in the office of a large business concern, and I have since had many opportunities for advancement. My present salary is \$100 per month, and I am confident that I am well equipped to handle any position that may be offered me."—L. R. ELSENBER, Michigan.

"Your training in Traffic Management, which I took at LaSalle, has enabled me to secure a position in the office of a large business concern, and I have since had many opportunities for advancement. My present salary is \$100 per month, and I am confident that I am well equipped to handle any position that may be offered me."—L. R. ELSENBER, Michigan.

Words cannot express how much I appreciate your advice and the position which I have secured. As a result of the training I have received, I am now employed in the office of a large business concern, and I have since had many opportunities for advancement. My present salary is \$100 per month, and I am confident that I am well equipped to handle any position that may be offered me."—L. R. ELSENBER, Michigan.

"Passed the Arizona bar examination last week at the head of a class of seven men, including graduates from some of the best-known resident

law schools in the country. I certainly do appreciate what LaSalle has done for me and feel a great debt to the LaSalle course and the methods of teaching your course."

C. A. LARSEN, JR., Arizona.

"Your course in Modern Salesmanship has given me many ideas and suggestions in the field of selling. I am now employed in the office of a large business concern, and I have since had many opportunities for advancement. My present salary is \$100 per month, and I am confident that I am well equipped to handle any position that may be offered me."—L. R. ELSENBER, Michigan.

CLARENCE A. EVANS, Ohio.

"When I enrolled in your Business Management course I was just a young man with no special qualifications. But I have since had many opportunities for advancement. My present salary is \$100 per month, and I am confident that I am well equipped to handle any position that may be offered me."—L. R. ELSENBER, Michigan.

What Will YOU Write Home to the Folks?

What does the future hold for YOU?

Will it be a steady climb up the ladder of success? Or will it be a long, hard struggle to get on your feet? The answer lies in the hands of the man who is serious in his desire to increase his earning power. Will he work and wait, and wait the coupon NOW?

The man who is serious in his desire to increase his earning power will do well to work and wait, and wait the coupon NOW.

LaSalle Extension University

The Largest Business Training Institution in the World
Dept. 1003-R Chicago, Illinois

Look for next the book "Ten Years' Promotion in One" and material on the development of the course and service that it offers. It will give you the most complete and up-to-date information on the subject of business training, and will show you the way to success.

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Big Electrical Jobs at Amazing Salaries Given to His Graduates



Never before has there been such a demand for men in the fascinating, Big Pay Field of Electricity. And it is for the big supervising jobs that pay the biggest salaries that there is the most need for men. Industry has come to look to S. V. Smith for trained men for these jobs for his graduates are found to be the most expert with the thorough knowledge of electricity from the ground up, that is necessary for superintendence, foreman, electrical technicians and equipment managers to have. Even common



Superintendent
\$10,000 A YEAR

ordinary electricians are making big money but today men trained by Mr. Smith are drawing salaries almost unheard of. Yet Mr. Smith trains men right in their homes by a wonderful

NEW EASY WAY to Learn ELECTRICITY—\$500 A MONTH EASY

It is now made possible for any one, regardless of education or experience, to be trained for these big pay jobs. By an amazing new easy system discovered by Mr. Smith it is made possible to give actual shop practice to the student right in his own home. Everything is so clearly explained and so wonderfully illustrated with original cuts, pictures, diagrams, plans and designs—and Mr. Smith's own personal supervision is so thorough that he guarantees your success. It is the only system by which actual shop practice can be given the student in his home.

Every Branch of Electricity

NO matter what you want to learn, you will find it in this wonderful course. You are taught all types of electrical work, such as house wiring (paying \$8.00 a day up); central and sub-station operating and maintenance (\$2500 to \$10,000 a year); automobile and tractor starting, lighting and ignition (\$35 to \$85 per week); electrical jobs and battery station service (\$40 week to \$20,000 a year). You are taught motor maintenance, armature winding, illuminating engineering and line construction. You are fitted to start right out and make good at any of these jobs. But the best thing about this training is that with the thorough knowledge of all these things you are fitted for the jobs at the top of your profession—the big pay jobs that give you the most important positions.

Men Needed

Every day Mr. Smith gets requests for men of this sort and it is only through the Home Study Department of the S. H. Electrical Works that these men can be trained. If you want to get out of the Low Pay rut, study Electricity, as it is the most fascinating and best paying field in the world. And when you enter this profession you cannot afford to be without the prestige and backing of the S. & H. Electrical Works.

Free Outfit

There is such a call for men that Mr. Smith is now offering free a complete outfit of electrical apparatus, instruments and appliances for experimental and practical home work to those who enroll with him immediately. By sending the coupon below you will be entitled to this offer whether you enroll now or later—but you must send it immediately. Now is the time to act—don't take a chance of losing this big free offer and get the information that will open a wonderful career to you. Mail the coupon now.

S. V. SMITH
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How To Get
The Better
Job in
Electricity

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Please send me details of your free offer to those who enroll now
understand this is free of charge and does not obligate me in any way

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"THE WORLD NEEDS ENGINEERS

—and is willing to
reward them with
honors, fame and money"



■ RALPH R. ARNOLD, County Engineer
Contra Costa County, California



In the beautiful County House
of Fame, located
Ralph R.
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Section of Frank C. ...
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way. It is ...
with 4 feet of ...
The ...

WHEN Ralph R. Arnold says that "the world needs engineers," it means something. For Ralph R. Arnold is County Engineer of Contra Costa County, California, and builder of the famous Franklin Canyon Road.

"Engineers are in demand," said Mr. Arnold the other day. "It is becoming harder and harder to get trained men.

"Very often, when a board of directors discusses the necessity of having some engineering work done, it is not a question of expense, but 'where can we find the man?'

"This is a regrettable state of affairs from an economic standpoint, perhaps, but it offers big opportunities for the trained man.

"Too many young men simply drift along in some routine work that doesn't interest them. Every man ought to soberly face the facts, and ask himself—'Do I want to make this my life's work?'

"If there is any formula for success it is this: Decide early in life what you are going to be. Study every angle of that business or profession. Get into the business in a practical way as soon as possible. Then 'work like the dickens' and continue studying.

"Maybe I lay too much emphasis on study, but I don't think so. The hours I spent at home studying my I. C. S. course meant so much to me that I'm naturally enthusiastic. With present day facilities for studying by correspondence there is absolutely no excuse for a man not being a success. Why, even to-day I refer to my old I. C. S. instruction papers several times a week on some particular problem. That shows how practical they are!"

MR. RALPH R. ARNOLD is only one of thousands upon thousands of men who have started from nothing and won their way to the high places by sheer grit and spare-time study.

If you will supply the will the International Correspondence Schools will supply the way.

For it is the business of the I. C. S. to prepare men and women for bigger jobs and larger salaries—in engineering, in architecture, in advertising, in salesmanship, in more than 300 other lines of work.

At least find out how, by marking and mailing the same coupon that has meant so much to so many other men just like yourself. It doesn't obligate you in any way to do this—it takes only a moment—but it may be the means of changing your entire life for the better. Why not do it now?

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 2058 C, Scranton, Penna.
Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject listed which I have marked on X.

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| <input type="checkbox"/> Printing and Bookbinding | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accounting (including C.P.A.) | <input type="checkbox"/> Business French |
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| <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Civil Service and Building |
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| <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Architectural Estimating |
| <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Architectural Rendering |
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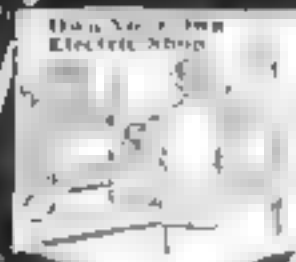
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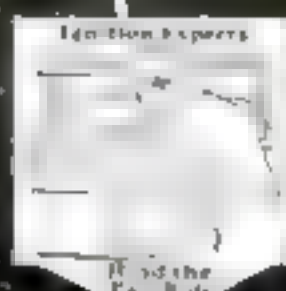
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If you're a Fanatic

How much money do inventors make—or lose?

Raymond Francis Yates

American Society of Mechanical Engineers

American Institute of Electrical Engineers

Institute of Radio Engineers

American Physical Society

OVER 70,000 patents were allowed in this country last year, but only about 3500 had any real commercial value. Most of the 3500 practical inventions were developed by professional inventors, while most of the impractical inventions were the work of "free-lance" inventors—men and women who suddenly decided that they had an idea for an invention, and immediately set about to perfect it.

Of course there must be some reason why the trained inventor is so often successful in his inventions, while the untrained inventor so often fails. Probably the greatest cause is that most people believe invention to be a "hit or miss" proposition—an out-and-out gamble. That is why so many would-be inventors waste years of effort, eat deep into their savings to work on inventions which can never bring them a penny, why still others who do produce worthwhile inventions lose their rights in them or receive only a pittance for their hard work.

What Invention Is

It doesn't require much thought to see that invention cannot be a matter of pure luck. Neither is it, as some people seem to think, something which only a genius can do. As a matter of cold fact, invention—successful invention—is nothing more or less than the careful, methodical use of certain fundamental facts, which anybody can learn easily.

It may seem strange to you that invention can be learned exactly as you learned reading, writing and arithmetic. Yet proof of this is easy. You will admit that if, as I have said, invention can be studied like any other profession—like mechanics, law, book-keeping, medicine—then those who do learn it should be able to produce many different kinds of inventions.

Of course you are familiar with Edison's inventions. Here are additional examples of less known inventors. Christopher N. Spencer first invented the breech-loading repeating rifle, which he followed by inventing the thread-spooler, the automatic turret-lathe, the automatic screw-machine, the "pump action" repeating rifle. He was also part-inventor of the drop hammer. B. T. Habbitt of soap fame, invented the process of wrapping and pressing laundry soap in cakes, besides inventing the first commercial baking powder, floating white soap, commercial cellophane, and several railroad devices. Henry Gaisman, inventor of the Auto-Siron Safety Razor, is also the inventor of the Autographic Kodak which he sold outright for \$300,000.

How Inventions Are Made

That, you will agree, answers the question, "How much money do inventors make—or lose?" If the inventor knows what he is doing, if he has studied the principles of invention and uses them, he is bound to make money. But if the would-be inventor merely takes a chance without any real

thought of what he is doing or how to do it, the chances are a hundred to one that he won't make a cent.

However, Inventive Science is easy to learn, because everybody—every man, every woman—is born with the inventive instinct. You will understand better what I mean when you realize that an invention is only a device which *fills* or *improves* something.

All inventions are made just this way. First some need is seen and recognized: new amusements, better light, better power, cheaper transportation, better automobiles—any one of a thousand needs which are impressed upon you every day. The next step is to find a means or a law which answers the need—first through some mechanical, physical or chemical law. Finally comes the actual work of giving form where you develop your ideas along the simple, exact lines of Inventive Science, and then protect and market your invention for your greatest profit.

More Inventions Needed Now

I said before that an invention is merely a device for satisfying some need or improving some other device so that it will work better, faster or cheaper. And, because the world today needs vastly more things than it needed 500 years ago, the demand for inventions is so much more urgent.

It isn't necessary that you must invent something like the steam engine to make money. Little inventions, such as the erasing ball pen, the metal and kap rubber tip, or the pencil have all brought in or inventors great fortunes. Gillette, it is reported, has received \$2,500,000 a year for his invention of the Gillette Safety Razor.

To show you what a little invention can bring you in real money, let me tell you the story of two very simple inventions.

The man who invented the Kiddie-Kar (which he produced in his search for a new cheap amusement for his children) is now worth, it is said, more than \$5,000,000. Success Magazine a few months ago told the story of a woman who, bothered by a shaky table, fixed up a little wedge-shaped piece of wood. Out of that simple idea she developed an invention which has brought her amazing success.

It doesn't matter what work you do, what your education has been or where you live—you can learn to develop successful inventions. Like the man who invented the Kiddie-Kar you may win a fortune through some device to amuse your children. Even a new kind of kitchen knife to make your wife a work easier can make big money for you. Your daily occupation in the office, in the factory, on the farm, your experiences at home or traveling gives you thousands of ideas every day which can be completed as wonderful inventions. And remember that the world is waiting for more inventions now and will pay big money for even the simplest idea.

You Can Learn Invention At Home

Hereto the average person has had little



chance of success in invention, because he lacked the necessary instruction in the few essential points of Inventive Science. Now, however, everybody who wants to invent can take advantage of a remarkable new course devised by fifteen of America's inventors (I am one of them), which shows the right way to practical and useful invention. For the first time the many inventions used by Edison, Marconi, Sperry, De Forest and every other great inventor are explained in such simple, easy-to-learn language that everybody can learn to use them.

No longer is it necessary to spend years in useless effort learning the little secrets which make invention easy. No longer need you waste time on inventions which will never bring you a penny. No longer need you be the victim of unscrupulous persons because you don't know how to protect your rights.

In a fascinating, easy course of 25 "common sense" lessons you are told how to look for ideas for practical money-making inventions, and where they are most likely to be found. You are informed how to develop these ideas quickly and at the least expense. You learn how successful inventors work, the materials they use, where and how they collect their information, the shortcuts they use.

Most important of all you learn how to keep records of your invention to prove priority of origin, how to get patents in the United States and in foreign countries, how to select and deal with patent attorneys, how to protect your patent rights. Finally you are told about that part of Inventive Science which finally makes for success or failure. You are given hints as to the best way to dispose of your patent—how to sell it outright or on royalty, how to organize a company or form a partnership to properly sell your invention so you will get greatest protection and make greatest profit.

All these things and hundreds of others have been learned by other inventors only after paying a terrific price in long years of unceasing labor, of discouragement and of failure. Now you can get them without effort without discouragement or failure so that a few minutes each day through this absorbingly interesting home-study course.

Everything Explained in New FREE Book

A wonderful book has just been written explaining this course in further detail. If you are genuinely interested write for it today, and it will be sent to you free. Learn more about this new course in Inventive Science. Find out how you can learn the secrets of successful invention in a remarkably short time right in your own home. Learn how you can become an inventor, how you can turn a simple little idea into a fortune. It doesn't cost you a penny, so mail the coupon now. The Bureau of Inventive Science has no connections with patent attorneys, and upon offers or promoters. Its only purpose is to give you the facts and women the facts which help them make invention pay.

BUREAU of INVENTIVE SCIENCE
Dept. 210, Wiener Bldg., Rochester, N. Y.

Bureau of Inventive Science, Dept. 210 Wiener Bldg., Rochester, N. Y.	
Please send me your free book, "The Science of Invention."	
Name	Age
Address	
City	State



Raymond F. Yates, who gives hundreds of thousands of men and women the facts which help them make invention pay.



PLAY PIANO BY EAR

Be a Jazz Music Master

Anyone Who Can Remember a Tune Can Easily and Quickly Learn to Play Popular Jazz or American Rhythm By Ear at a Very Small Cost. The New Niagara Method Makes Piano Playing Wonderfully Simple.

No matter how little you know about music—even though you "have never touched a piano"—if you can just remember a tune, you can quickly learn to play by ear. I have perfected an entirely new and simple system. It shows you so many little tricks that it just comes natural to pick out on the piano any piece you can hum. Beginners and even those who could not learn by the old fashioned method, grasp the Niagara idea readily, and follow through the entire course of twenty lessons quickly. Self-instruction—no teacher required. You learn many new styles of bass, syncopation, blues, fill-ins, breaks and trick endings. It's all so easy—so interesting that you'll be amazed.

A Simple Secret to Success

No need to devote years of study to learn piano nowadays. Special talent unnecessary. Every lesson is so easy, so fascinating that you just can't keep your hands off the piano. Give it part of your spare time for 90 days and you will be playing and entertaining almost before you realize it. No tiresome scales, no arpeggios to learn—no do re mi—no difficult lessons or meaningless exercises. You learn a bass accompaniment that applies to the songs you play. Once learned, you have the secret for all time—your difficulties are over and

You Become Master of the Piano

Even talented musicians are amazed at the rapid progress of Niagara School students and can't understand why this method was not thought of years ago. Naturally, the Niagara Method is fully protected by copyrights and cannot be offered by any other school. A special service department gives each pupil individual attention.

**Learn at
home in
90 days**

Be Popular in Every Crowd

One who can sit down at any time without notes or music reel off the latest jazz and popular song bits that entertain folks, is always the center of attraction, the life of the party, sought after and invited everywhere. Make yourself the center of attraction—master the piano by spending an hour a day studying the fascinating Niagara Method.

As easily as thousands of others have learned, so you, too, can learn and profit—not only through the pleasure it provides, but also by playing at dances, motion picture houses and other entertainments.

Decide to Begin Now!

Just spend a part of your spare time with a few easy, fascinating lessons and see how quickly you "catch on" and learn to play. You will be amazed, whether you are a beginner or an advanced student.

Write for interesting, illustrated booklet, "The Niagara Secret"—it describes this wonderful new method of playing piano by ear. **This booklet sent FREE.**

Ronald G. Wright, Director, NIAGARA SCHOOL OF MUSIC, Niagara Falls, N.Y.



**This Book
FREE**

CLIP THIS COUPON NOW

Niagara School of Music, Dept. 587, Niagara Falls, N.Y.
Without obligation mail me your booklet, "The Niagara Secret."

Name _____

St. and No. or R. F. D. _____

Town _____

Age _____

State _____

Ever take piano lessons? _____

How many? _____

Copy this Sketch!



I AM anxious to find men with a desire to become draftsmen. With business picking up everywhere many thousands of draftsmen will be needed at salaries up to \$3000 to \$3600 per year.

In asking you to copy this sketch I am sure I will be able to tell from the sketch you send in what kind of an opportunity you will have in this great profession.

There are no conditions requiring you to buy anything. You are under no obligation in sending in your sketch.

FREE!

\$80 Drafting Course

To every student enrolling now I give an opportunity of getting an \$80 drafting course absolutely without cost to him. So send in your sketch today and learn all about this offer.

For Sending Copy of Drawing

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To every person of 18 years or older sending a sketch I am going to mail free and prepaid the Draftsman's Pocket Rule shown above. This will come to you entirely with my compliments. With it I will send you a 6x9 book on "Successful Drafting".

Salaries up to \$250 and \$300 a Month

Positions paying up to \$250 and \$300 per month, which ought to be filled by skilled draftsmen are vacant everywhere. There are in every part of this country ambitious men, who with practical training and personal assistance, will be qualified to fill these positions. Mr. Dobe guarantees to train you UNTIL placed in a permanent position at a salary up to \$250 and \$300 per month.

FREE \$25 DRAFTING OUTFIT



Mr. Dobe will give you this entire outfit free if you enroll at once. Don't delay. Send for full information TODAY!

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and Get Ivorian Pocket Rule Absolutely Free! Ambitious men, interested in drafting, hurry! Don't wait! Send in your sketch or request for FREE Book and Ivorian Pocket Rule Address:

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1841 Lawrence Ave., D-12-27 Chicago, Ill.

Money Making Opportunities

HELP WANTED

IF a detective furnished opportunity to earn big money from thousands of details offered in terms of \$100,000.00. This is a new and exciting way to make money. 124 West 10th St., New York City.

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A RAISE IN SALARY

In Two Weeks

By
Raymond A. Dobe



BE A RAILWAY TRAFFIC INSPECTOR

SEVEN months ago I sat by the old farm fence, discouraged, with no encouraged chance for a prosperous, active future.

Humbly inserted in a corner of a little farm magazine was a Railway Traffic Inspector ad. Through curiosity I invested a postage stamp and inquired.

When I read what the S. B. T. I had done for others through their training, I made up my mind to let them do the same for me. They have lived up to their agreement.

When I commenced taking this course all I was good for was to pitch hay and milk cows. I was not contented with this life and every day was a day of drudgery.

A Dream Came True

A dream of a future has come true inside of a term of a few short months. I am now a full-fledged Traffic Inspector on a large electrical system in one of the largest cities of the United States—thanks to the S. B. T. I.

The S. B. T. I. pays more at the beginning than the Institute guaranteed me. I am told by the manager that my work is satisfactory and that he will give me a raise in salary in two weeks if it continues to be so.

My advice to the fellow who is on the fence, watching his head, is to do as I have done, enroll with the Standard Business Training Institute and let them build a future for you.

I shall always be pleased to recommend this school to anyone.

EARN UP TO \$250 A MONTH

EXPENSES PAID

Present beautiful outdoor work, excellent chance for advancement, excellent with railway executives. Travel or remain near home.

Prepare at home in spare time. Position GUARANTEED paying at least \$110 a month and expenses of tuition refunded.

YOU TAKE NO RISK

Send coupon at once for details of this fascinating, unexcelled profession. If we don't get you a position, the training costs you nothing. Act now!

Standard Business Training Institute Buffalo, N. Y.



Standard Business Training Institute Buffalo, N. Y.

Send me, entirely free, Booklet No. 2-44, giving full particulars about course in Railway Traffic Inspection.

Name

Street

City

More Money Making Opportunities
on pages 4 to 18

If New Hair Doesn't Grow After Using My Method —I Don't Want a Penny!

I mean just exactly what I say! I don't care how thin your hair may be—I don't care how many treatments you may have taken without results. If my new discovery won't restore your hair, I don't want to keep a cent of your money! Furthermore I'll send you the proof of what I have done for others entirely FREE! Just mail the coupon below.

By ALOIS MERKE

Founder of Famous Merke Institute, Fifth Ave., New York

AFTER 17 years' experience in treating baldness—which included long years of experimentation in Heidelberg, Paris, Berlin, Geneva, Cairo and other centers of scientific research—I have discovered a startling new way to promote hair growth.

At the Merke Institute, Fifth Avenue, New York—which I founded—I have treated scores of prominent stage and social celebrities. People are coming to me from all parts of the country to gain the benefits of my discovery. Many pay as high as \$500 for the results I have brought them.

Yet now, through a series of ingenious inventions, I have made it possible for every one to avail themselves of my discovery—right in their own homes, and at a cost of only a few cents a day!

My Unusual Guarantee

I know you are skeptical. I know that you have tried perhaps dozens of different remedies and treatments without results. I know that you have wasted time and money on treatments which by their very nature could NEVER restore your hair. All right. Perhaps my treatment cannot help you, either. I don't know. But I do know that it has banished falling hair and dandruff for hundreds of others—often with the first few treatments. I do know that it has already given thick, luxuriant hair to people who long ago had despaired of regaining their hair. And I am so downright positive that it will do the same for you that I am entirely willing to let you try it at my risk—and if it fails to restore your hair, then I'll instantly—and gladly—mail you a check, refunding every cent you have paid me. In other words, I absolutely GUARANTEE to grow new hair on your head—and if I fail, then the test is free.

Entirely New Method

What is my method? It is entirely new. It is entirely different from anything you ever heard of. No massaging—no singeing—no "mange" cures—no unnecessary fuss or bother of any kind. Yet results are usually noticeable even after the very first few treatments.

Many people have the idea that when the hair falls out and no new hair appears, that the hair roots are always dead.

I have disproved this. For I have found in many cases which have come under my observation that the hair roots were NOT dead, but merely dormant! Through undernourishment, dandruff and other causes, these starving, shrunken roots had literally gone into a state of "suspended animation." Yet even if the scalp is completely bare, it is now possible in the majority of cases to awaken these dormant roots, and stimulate an entirely new growth of healthy hair! I KNOW that to be true—because I do it every day.

Ordinary measures failed to grow hair because they did not penetrate to these dormant roots. To make a tree grow, you would not think of rubbing "growing fluid" on the bark.



Instead, you would get right to the roots. And so it is with the hair.

In all the world there is only one method I know about of penetrating direct to the roots and getting nourishment to them. And this method is embodied in the treatment that I now offer you on my positive guarantee of satisfactory results, or the trial costs you nothing. The treatment can be used in any home in which there is electricity.

Already hundreds of men and women who only recently were bald or troubled with thin falling hair, have through this method acquired hair so thick that it is the envy and admiration of their friends. As for dandruff and similar scalp disorders, these usually disappear after the first few applications.

Remember—I do not ask you to risk "one penny" in trying this treatment. I am perfectly willing to let you try it on my absolute GUARANTEE—and if after

30 days you are not more than delighted with the growth of hair produced, then I'll gladly return every cent you have paid me. I don't want your money unless I grow hair on your head.

Free Booklet Explains Treatment

If you will merely fill in and mail the coupon below I will gladly send you—without cost or obligation—an interesting 32-page booklet, describing my treatment in detail.

This booklet contains much helpful information on the care of the hair—and in addition shows by actual photographs what my treatment is doing for others.

No matter how bald you are—no matter if you are completely bald, this booklet will prove of deepest interest to you. So mail the coupon now—and it will be sent you by return mail.

ALLIED MERKE INSTITUTES, Inc.

Dept. 1710

512 Fifth Ave., New York City.

Actual Results

(Dozens of letters like the following are received every day by the Merke Institute.)

"In the short time I have used your treatment I have gotten remarkable result. My hair has disappeared entirely. My scalp is now all full of fine new hair. Would not just wish my treatment for 10 times its cost." A. W. B.

"The top of my head is now almost covered with new hair about one-half inch long. I have been trying five years, but could never find anything to make my hair grow again your treatment." T. C.

"Ten years ago my hair started falling. I used hair tonics constantly, but four years ago I displayed a perfect full moon. I tried everything, but without results. Today, however, thanks to your treatment, I am pleased to inform you that I have quite a new crop of hair one inch long. My friends are astonished at the result." F. H. B.

ALLIED MERKE INSTITUTES, Inc., Dept. 1710
512 Fifth Avenue, New York.

Please send me, without cost or obligation on my part, a copy of the new booklet describing in detail the Merke Institute Home Treatment.

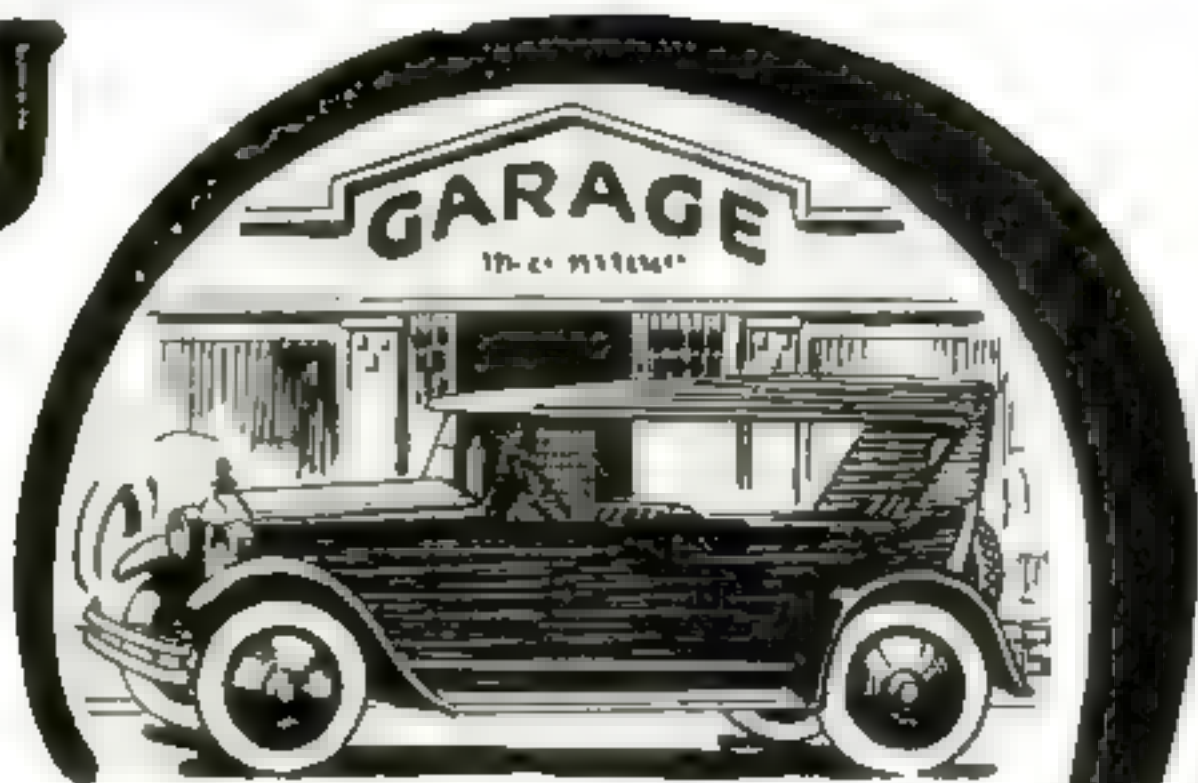
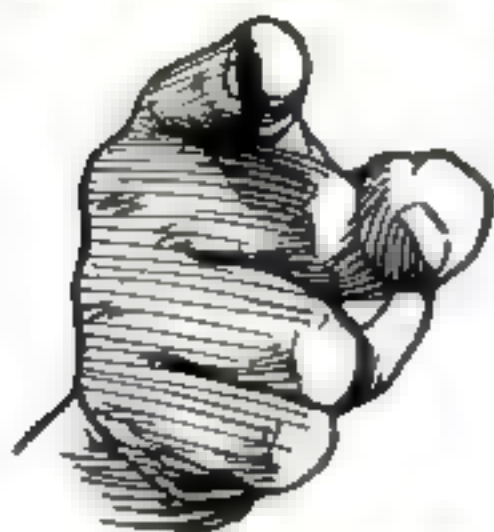
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Address.....

City.....

State.....

YOU



WHAT ABOUT AN AUTOMOTIVE JOB *Paying \$50 to \$125 per Week*

You can have one after a few short weeks of mighty interesting training at Greer College. Never before in automobile history has there been such a demand for expert automobile workmen. Hundreds of requests for Greer Graduates are now in our files, waiting to be filled. We want more ambitious students to qualify for the big money jobs.

We want YOU—AT ONCE.

Paying Jobs Furnished While You Learn

We can place you in positions paying up to \$30.00 per week while you learn. With this help you can get through easily. In 8 short weeks you can graduate as a Certified Automotive Engineer with a lifetime of big earnings ahead of you.

Complete Greer Course includes Machine Shop Practice, Shop Management, Selling, Truck, Tractor and Automobile Repairing in the big Greer shops, Lighting, Starting, Ignition, Tire Repairing, Storage Batteries,

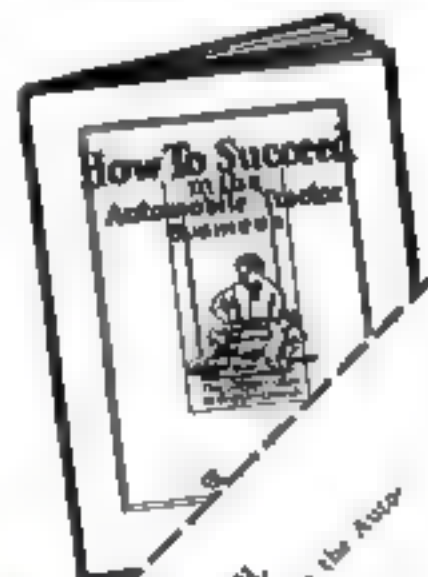
Driving—Everything you need to qualify you for high paid positions anywhere.

Day and Evening Classes

Your work need not interfere with your Greer studies. Classes are suited to your convenience.

Write, call or 'phone for your earn-while-you-learn job—and send the coupon for FREE BIG Booklet "How to Succeed in the Automobile Business," all about automobile and garage work. Act now, while there is still room for you

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Coupon
for this
**FREE
BOOK**
Now!



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of Automotive Engineering

2040 S. Wabash Avenue,

Chicago, Ill.

ERWIN GREER, President
2040 S. Wabash Avenue, Chicago, Ill.
Send for your Free Book "How to Succeed in the Automobile Business" and Special Tuition Offer

Name _____
Address _____

THEY SAY—

Brief Bits of Timely Comment on the Sciences of the Hour



PROF. A. M. LOW, the "Edison of England," whose wonderful invention for photographing noise has been used successfully in the London underground railways. He is shown above watching the motor races at Brooklands, Eng., where the exhaust noises of the competing cars were measured by his device.

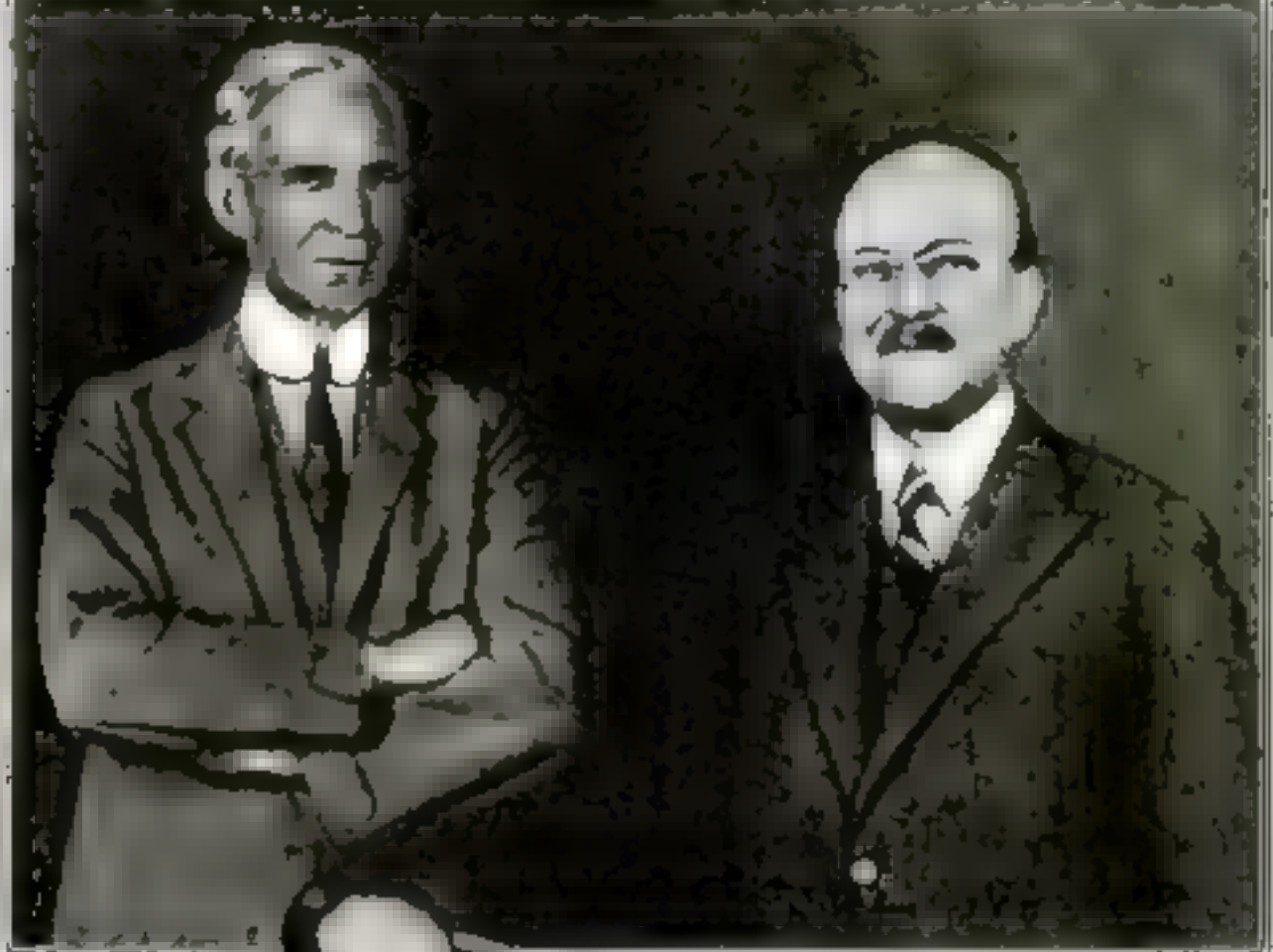
"European scientists are on the eve of announcing one of the greatest discoveries of the age—flexible glass. I am confident that their experiments will prove successful within two years. Then we may possibly see the folding window-panes, the collapsible electric-light bulb and unbreakable dishes."

DR. ALES HRDLICKA, of the National Museum in Washington, D. C., and head of the American School for Prehistoric Studies in Europe, who is now directing a party of scientists visiting western Europe in search of prehistoric man.

"It seems to be becoming more and more likely that man himself originated in western Europe. Archeological specimens representing man's history from the earliest part of the Ice Age and possibly before have been recovered in great numbers from this field. The museums of Paris, Brussels, London, and Prague are filled with them. But vast deposits are still unexplored."



Dr. Ales Hrdlicka



DR. E. F. PHILLIPS, head of the bee station of the United States Department of Agriculture at Somerset, M.I., who has discovered many interesting new facts about bees.

The average bee, which weighs about 75 milligrams, will produce about seven times its weight in honey during its lifetime. Yet bees sometimes are lazy. Contrary to popular belief, the bee's sting is essentially for protection against attacking stranger bees.

DEAN ALBERT C. EYCLESHYMER, of the College of Medicine, University of Illinois.

"The search for the elixir of life is about at an end. In this chase after eternal youth, medical science has succeeded in prolonging life 16 years. Regularly plain diet and exercise are the basis of longevity. We should all live to be 100 years old."



Sir Joseph Thomson

ANDRÉ CITROËN, automobile manufacturer, known as the "Henry Ford of France" at right, photographed with Henry Ford during the Frenchman's recent visit to America.

"I think there is plenty of room for more cars in America. Americans like something new and they like it quick and good. I intend to build a factory in America soon and expect to be manufacturing cars there by February. I have found that American engineers can give me great help in improving the rate of output and solving problems to which French helpers are unused. I have picked in America some skilled men, the best of whom I had not found before, and they are to be paid in my French plants. I expect by their aid to triple the output of my factory."

SIR JOSEPH THOMSON, British scientist and discoverer of the electron, who recently witnessed the progress of American engineers with his theory of electrons, and who now predicts that science will discover a new kind of water.

"The discovery of a substance that will break down one of the hydrogen electrons in the water molecule would make possible another kind of water. There is no reason why, with a strong enough agent, another kind of water could not be discovered."

"Music and Beauty make life pleasant"
Yang Chu.

The New **GREBE** Broadcast Receiver

delights both ear and eye.

Doctor May.

REGENERATION and Tuned Radio Frequency Amplification find their first successful combination in this Receiver. The 20-foot sub-covered wire, readily concealed behind the picture moulding, is the only antenna required.

The attractively finished walnut cabinet has compartments for all necessary batteries.

Write for "GREBE Radio in the Well Appointed Home"



A. H. GREBE & COMPANY, Inc.
Richmond Hill, N. Y.
Western Branch: 454 East 313 St. Los Angeles, Cal.



FIG. 2



What Static Sparks Cost Us

Science Teaches Motorists How to Protect Themselves Against a Danger in Fuel that Is More Deadly than Dynamite

By Raymond J. Brown

THROUGH the deaths of three motorists, all occurring within a week recently in widely separated parts of the country, attention of automotive engineers has been focused upon an old but deadly peril in the gasoline tanks of automobiles. It is the danger of explosion and fire from the ignition of gasoline fumes by static electricity.

The tremendous scope of this newly discovered danger is apparent when we realize that more than 11,500,000 automobiles in daily use in the United States consume annually almost 2,500,000,000 gallons of gasoline—a fluid more dangerous than dynamite if not carefully handled.

Many Fires

Organizations concerned directly or indirectly with fire perils suddenly have discovered that many disastrous fires, the origin of which was shrouded in mystery, actually were caused by static sparks coming in contact with the fumes of gasoline. As a result they are hastening to perfect preventive measures that will lessen this real source of property damage and death.

The American Petroleum Insti-



These photographs show how a huge gasoline tank truck was demolished by an explosion due to static electricity at a way side service station in Downey, Calif. The steel tank at the right was blown 48 feet



Protecting a tank truck from static sparks. Arrow points to dragging chain attached to chassis. This serves as a

ground connection to carry off static electricity generated by friction of gasoline flowing through filling hose

tute has forwarded a comprehensive questionnaire on the subject to oil producers and dealers in an effort to standardize proper methods of protecting gasoline tanks and tank wagons from the hazards of static. The National Board of Fire Underwriters has issued a bulletin explaining in detail the fire danger that always accompanies gasoline.

The American Society of Electrical Engineers and the United States Bureau of Standards have been designated by the American Engineering Standards Committee as a joint committee to formulate codes for the protection of gasoline against lighting, and of course static, which is potential lightning in miniature. The gravity of the problem is revealed by such activities as these.

What Is Static?

Static electricity may be generated in an infinite number of ways. Wherever there is friction it is likely to be produced. It is static that crackles in your hair when you apply a rubber comb in the winter-time. It is static that causes sparks to jump from your fingers when you touch a metal object or the hand of another person after walking a long way on a carpeted floor. Usually these sparks will do no harm, but, if generated where gasoline vapor has combined with the air in explosive proportion—above the gas tank of

Courtesy Sinclair Consolidated Oil Co.

your car, or in any garage, service station, filling station, dry-cleaning establishment; in fact, anywhere where gasoline is used—static sparks may cause disastrous fires and explosions.

How easily and peculiarly static electricity may be generated with dangerous effect is shown by an incident last winter in a city of the Middle West. A physician, roused from his bed by an urgent night call, donned a fur-lined overcoat and rubber boots. He walked to his garage, and as he started to enter his automobile, there was a blinding flash, and an explosion. The machine burst into flames. The automobile was destroyed and the physician badly burned.

Static electricity, generated by the rubbing of the fur of the coat against the rubber boots, was the cause of the fire. The rubber soles insulated the doctor from the ground, as he walked, causing the electricity to be stored up in his body as in a condenser. Then, when his hand approached the metal body of the machine, the charge was discharged in a spark that ignited the gasoline fumes rising from the tank of the car.

Why Gasoline Explodes

Liquid gasoline is not dangerous in itself. Confined in a tank or can, it is quite "harmless." But the gas it gives off, combined in proper proportion with air, is highly explosive. Scientists have determined that the ignited vapor from a single gallon of gasoline can do as much damage as 83 pounds of dynamite. In fact, it is this very explosive force of air and gasoline that makes possible the powerful automobile engine.

A slight spark only is necessary to ignite this gas—the glowing end of a cigarette, a burning bit of match, a weak discharge of static. The peril is magnified by a physical property of the gas. Because it is heavy, the gas is not carried away by the circulation of air, but falls to the lowest level it can find, settling to the floor and filling all crevices. It sinks into garage repair pits, where it may remain for days unless an extraordinary current of air carries it away.

Gasoline fumes that had settled in a repair pit caused a violent explosion in a garage in the Middle West a few weeks ago. A mechanic, entering the pit to drain a crankcase, was unable to budge the plug with his pliers. As he exerted more force, the pliers slipped, striking a bolt head and causing a spark. Immediately the fumes in the pit exploded, burning the workman severely and badly damaging the car.

Gasoline rushing through the hose at a wayside filling tank generates static, which passes through the metal nozzle into the metal parts of the automobile. There it is stored up because the car is insulated from the ground by its rubber tires. Touching the car with any conductor of electricity will cause the static to be discharged. The

hand of the attendant at the filling station, or the hose nozzle as it is withdrawn from the tank may supply such a conductor. The resultant static spark, occurring over an open gas tank and near a spot where a greater or less quantity of gasoline is spilled every day, is bound to be dangerous.

Many automobile fires and explosions have occurred under these circumstances. Formerly fires occurring when the gas supply of cars was being replenished were attributed to backfire from the motors, or some other mysterious cause, but those



A filling station safeguard. Here a ground chain, attached to a metal post, is thrown over a metal part of the car.

Where Peril Lurks in a Tiny Spark

FIRE and explosion losses traceable to gasoline and oil, mounted in the United States from \$6,471,119 in 1918 to \$9,420,343 in 1921—an increase of nearly \$3,000,000 in three years. Experts now agree that a large percentage of these losses can be traced directly to the sparks of static electricity.

Like its big brother, lightning, static hurls its sparks at unexpected times and places. For that reason no specific rules can be offered as a sure safeguard against its dangers. Yet the average person, especially the automobile owner, will do well to observe a few general precautions: Don't allow uncovered gasoline to stand where sparks—from static or from other causes—may ignite the fumes and cause a disastrous explosion.

Guard against spilling gasoline on the floor of your garage or in your home. The gas it gives off is a potential destructive force more powerful than dynamite. A tiny spark is enough to set it off.

Carefully ventilate any enclosed place where gasoline fumes have been allowed to escape.

who have studied the question are certain now that the cause was static.

A noted automotive engineer investigating the danger of static reports an unusual incident of static generation. An automobile was backed up to a wire fence in such a way that the discharge from its exhaust struck against the wires. So much static was generated by the discharged gases impinging on the wire, that persons who touched the fence felt distinct shocks.

Static Responsible for Many Fires

Statistics of the damage done by gasoline fires caused by static are unavailable, because, as one engineer stated in a report to the Department of Agriculture on the question, "In most cases the evidence is destroyed." Fire authorities, however, agree that the total annual loss represents a considerable percentage of the total damage resulting from gasoline and oil fires. This damage, according to the latest reports of the National Board of Fire Underwriters, amounted to \$9,420,343 in 1921.

In Downey, Calif., static electricity, generated by gasoline flowing through a hose, recently caused a fire and explosion that killed eight persons. A 1700-gallon tank truck, filling the tanks at a service station, suddenly exploded. The tank was ripped from the chassis and hurled 48 feet through the air. Persons standing within 50 feet were enveloped in flames and their clothing burned from their bodies. Other persons 200 feet away were scorched and blistered and some of them thrown to the ground. All vegetation near the explosion was scorched.

The service station was demolished, and a frame bungalow that stood about 40 feet away was burned to the ground. Sunken concrete construction prevented the explosion of the five underground tanks in which gasoline was stored at the station, although the fluid was forced from four of the tanks through the vent pipes by internal pressure resulting from the external heat.

From a similar cause a garage in Marshfield, Wis., caught fire recently and automobiles valued at \$50,000 were destroyed.

Some Safeguards

For some time gasoline dealers have been using a simple but effective method of preventing fires of this sort. A chain is attached to the chassis of the gasoline tank truck and permitted to trail on the pavement. This supplies a ground connection for the truck and causes any static generated to flow harmlessly to the earth. The truck destroyed in the Downey explosion just mentioned was supplied with a ground chain, but faulty adjustment is believed to have been responsible for its failure to perform its function.

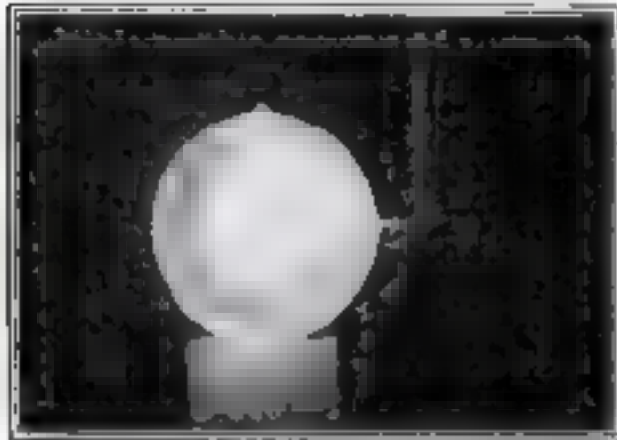
Some owners of gasoline filling stations recently have carried the ground chain idea further, supplying a

device which is used to ground every automobile that stops for gas. This consists simply of a metal chain attached to an iron pipe driven into the ground near the filling pump. When a car stops beside the pump, the attendant places the end of the chain on some metal part of the car. Thus the machine is protected should static develop as the gasoline flows into the tank.

The elimination of static by grounding also is being practiced on a smaller scale in dry cleaning establishments. Many fires occurring in these places have resulted from the generation of static by the rubbing of silk garments that are being cleaned. Experienced operators now dip their hands into the gasoline in which the garments are immersed and draw off the static charges, if any, by a grounded metal finger ring. This practice prevents the creation of a spark at the surface of the gasoline where it might cause a fire. Since static is generated in dry weather more readily than in damp weather, much of the danger in cleaning establishments is eliminated by discharging steam into the workroom.

High-Speed Movies—5000 a Second

Marvelous New Camera Watches a Hammer Smash a Vacuum Bulb



Photographed at the instant of impact



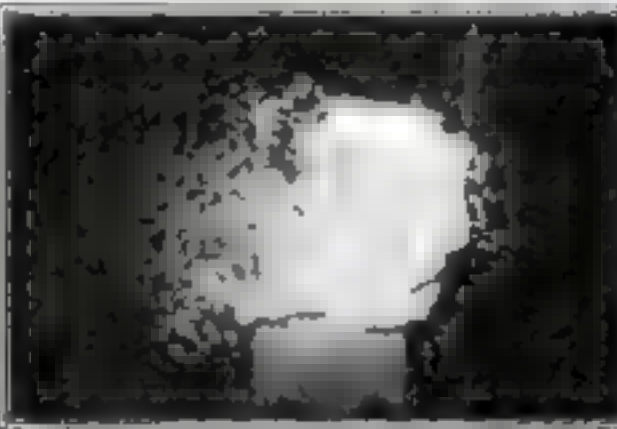
Appearance after 8/2500 of a second



Rush of air breaks opposite side



The impact side still little altered



The whole bulb is crumbling now



1/100 of a second after impact

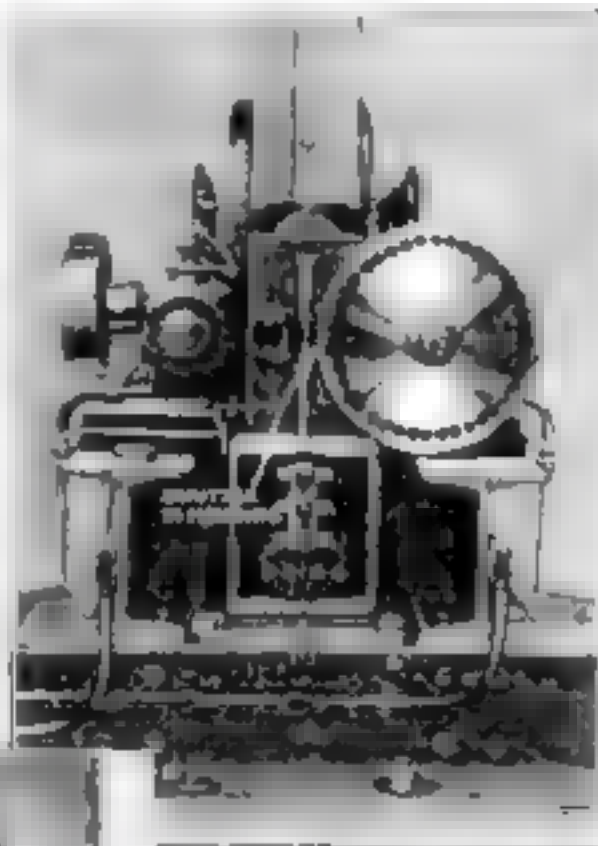
SIMULTANEOUSLY from the United States and England has come announcement of the invention of two revolutionary types of "slow motion" moving-picture cameras, capable respectively of making 3200 and 5000 exposures a second.

This permits the photographing in elaborate detail of actions the unaided eye cannot discern.

The bursting of a shell against armor plate, for example, which occupies less than one fiftieth of a second, by these wonderful cameras can be photographed in 100 pictures, which at normal projecting speed would be run off on a screen in between six and seven seconds. This enables scientific study to be made of each stage of a process that the fastest cameras hitherto devised have pictured as instantaneous.

Under the eye of the super-high-speed camera a rubber ball dropped to the ground is shown to be flattened almost into a hemisphere at the moment of impact, a circumstance which, by showing resiliency in detail, is of scientific value to the manufacturers in deciding on the design and construction of their products. Other secrets of rapid mechanical action that the cameras will disclose are expected to lead to industrial and scientific improvements.

The American machine was developed by C. Francis Jenkins, of Washington, D. C. The British camera is known as the Heape-Gryll rapid cinema machine. They are large contrivances (weight of the English machine is four tons) operated by electric motors.



This British high speed movie camera photographs "instantaneous" movements, making 5000 exposures a second. A section of this camera film is shown at left



Movie film showing how a rubber ball flattens at instant of impact

The two machines are quite dissimilar in operation.

In the Heape and Gryll camera, rolls of film are wound about each rim of a drum 58 inches in diameter. Before each film and at right angles to the turn of the drum, revolves a wheel containing 40 lenses, geared and sized to produce pictures three quarters of an inch deep, the standard size of motion-picture "frames" or images. Between the lens wheels and the film is the shutter, the entire mechanism

being operated by the one motor. Single exposures, when the machine is operating at maximum speed are never slower than 1/100,000 of a second.

Giant searchlights and chemical flashes are employed to furnish light. In photographing such things as the explosion of a shell the shell itself serves a wire in flight. This causes the camera to start at the precise moment of explosion, as the human hand is too slow to operate the switch.

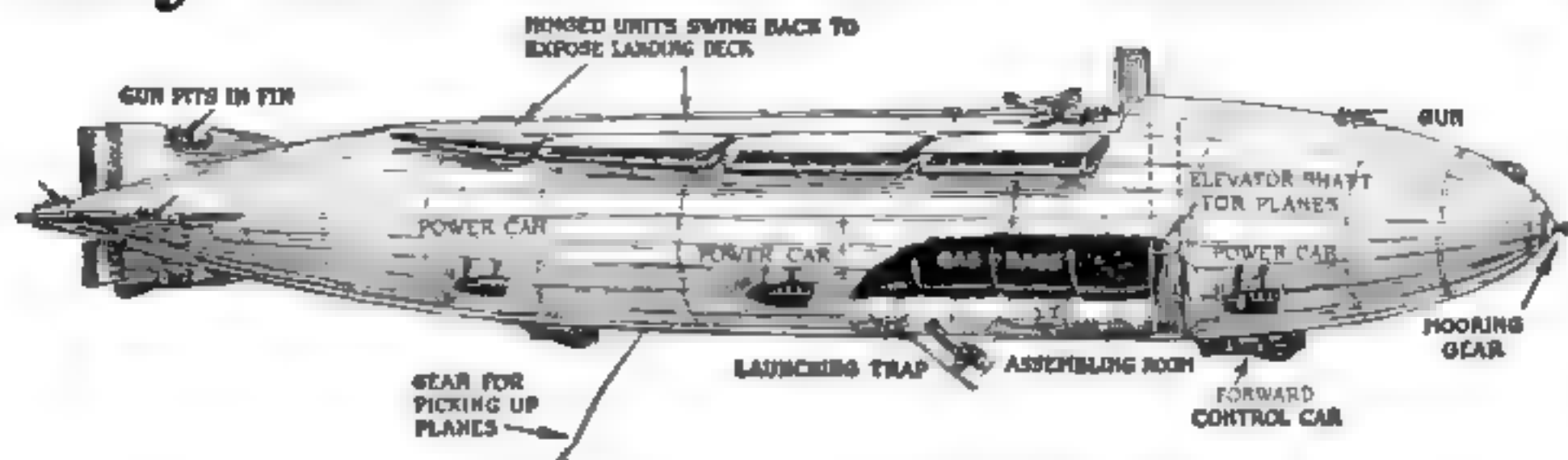
The Jenkins machine is smaller and simpler. It has a stationary lens and no shutter, and the movement of the film is continuous. Mr. Jenkins obviates a shutter and the necessity of halting the film each time it is exposed, by causing the beam of light that carries the projected image of the object being photographed to be bent progressively by a prism in the direction of the movement of the film. In short, the beam of light moves with the film and at precisely the same speed, flashing back to a new section of film each time an exposure is made.

The Scientific Detective

SCIENCE is making capture and punishment of the criminal so certain that eventually deliberate crime will disappear from the earth.

Such is the amazing prediction of Richard E. Enright, Police Commissioner of New York City. In a fascinating article written especially for the November POPULAR SCIENCE MONTHLY, Mr. Enright will tell how discoveries and inventions have made the modern detective a real scientist, eclipsing the exploits of *Sherlock Holmes* and other detective heroes of fiction.

Sky Leviathans of Tomorrow



Above is a diagrammatic representation of a possible monster plane-carrying airship of the future. In the accompanying article Rear Admiral Moffett predicts airships more than

900 feet long. Notice how hinged cover units are swung back to expose a spacious landing deck for airplanes. Alighting, the planes would be lowered into the body of the ship

By Rear-Admiral William A. Moffett

Chief of the Bureau of Aeronautics, United States Navy

SHIPS of the sea have built empires, altered the destinies of nations, and exerted a profound influence on history through uncounted centuries. With the dawn of the twentieth century, ships of the air have come as a new challenger of time and space, and their influence upon the trend of world events is today one of the most potent factors in world progress and development.

Yesterday we crossed an ocean, today a continent; tomorrow we circle the globe. New routes for commerce open up by way of the polar air routes. London and Tokio are drawn together as by magic, and man, creeping on the earth, looks to the sky and reads there the story of a new era.

It requires no great tax on the imagination to picture some of the developments of air transportation which we may expect to see even in our brief span.

Larger Dirigibles to Be Built

The Navy has built at Lakehurst, N. J., the first rigid airship ever constructed in the United States—the ZR-1. It has been called a giant ship of the air—over 2,000,000 cubic feet of gas will be required to inflate it. It is as large as ocean-going steamers. It can carry a useful load of 95,000 pounds, exclusive of crew and supplies, and withal is mediocre in size and inferior in performance to similar ships that may be expected to follow.

Consider a ship of 5,000,000 cubic feet. Such ships now are being planned abroad. They would equal the size of the *Leviathan*, with a length of 900 feet and more and a diameter greater than the beam of that great vessel. They will carry a weight in fuel and other useful loading of more than 60 tons and could cruise halfway around the earth without a stop. Airplanes could be carried on them as are lifeboats on ocean-going vessels. These planes could land on a deck on top of the airship and be launched from it, carrying passengers for wayside destinations. They could be designed to carry a regiment of troops, and a fleet of them could transport an army to the ends of the earth, in time that could be reckoned in hours.

Imagination—but not too much of it.

Airplanes already have been carried by airships, launched from them, picked up by

them. Polar air routes for short cuts by air commerce are considered the most logical development of dependable aeronautics. This assertion we have from such practical men of science as the noted explorer, Vilhjalmur Stefansson. And England will weld together her empire overseas with giant airships, capable of traveling 10,000 miles and equipped with passenger accommodations comparable to those of the finest transatlantic steamships.

In the light of what has been done by airships operating with airplanes, this development rivals in interest anything that has gone before in aeronautics. The future airship, developed for naval use, will carry a sting that will make it one of the most formidable contenders for supremacy of the air, sea, and earth that has ever been conceived. Allowing 60 tons of useful load to our air giant, we may set aside one half of this for fuel, which will leave 30 tons for planes, landing gear, guns, ammunition, and bombs. Superior types of fighting planes now in service use weigh less than a ton each. Other types of planes have been developed which weigh less than 1000 pounds.

It is well within the bounds of reason to predict that the naval airship of the future will carry a dozen planes that will be capable of defending her against air attack, and in addition will mount a battery of guns that will command the respect of any enemy marauder. Means of returning the planes to the parent airship could take the form of a landing deck, on top of the ship or suspended beneath it. Stowage space for the fighters could be provided in the body of the ship along the keel line. The launching of them is merely a matter of pushing the planes off into space, where they can recover themselves with the ease of a bird thrown into the air.

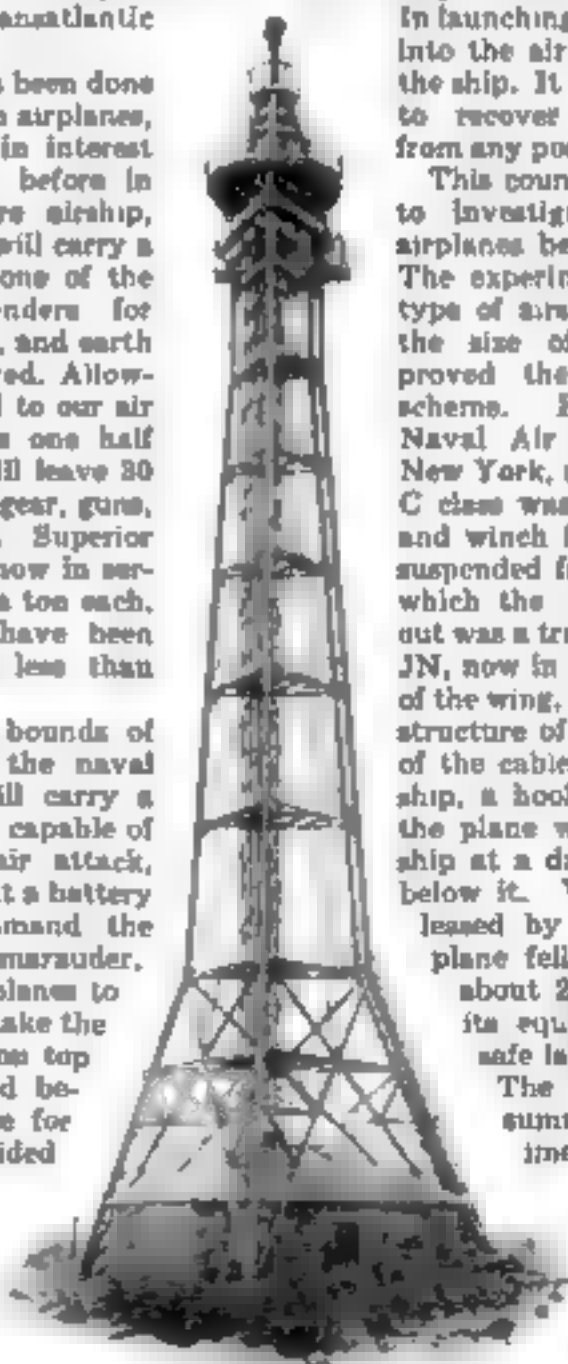
One of the problems involved is that of keeping the ship's center of gravity below the center line of the envelope. Any extensive structure on the top of the airship involving weight would affect the stability and performance adversely. To offset this obvious difficulty, planes once landed could be quickly disassembled and the fuselage and wings quickly passed through a well in the body of the ship to the stowage space.

In launching, they would be dropped into the air from the under side of the ship. It is no trick among airmen to recover equilibrium in flight from any position.

This country was among the first to investigate the possibility of airplanes being carried by airships. The experiment, conducted with a type of airship less than one tenth the size of those now building, proved the practicability of the scheme. Four years ago at the Naval Air Station in Rockaway, New York, a non-rigid airship of the C class was equipped with a cable and winch for carrying an airplane suspended from it. The plane with which the experiment was carried out was a training type known as the JN, now in service use. On the top of the wing, a ring was secured to the structure of the plane. On the end of the cable let down from the airship, a hook engaged the ring and the plane was suspended from the ship at a distance of about 50 feet below it. When the hook was released by a tripping device, the plane fell a vertical distance of about 200 feet, then recovered its equilibrium and flew to a safe landing.

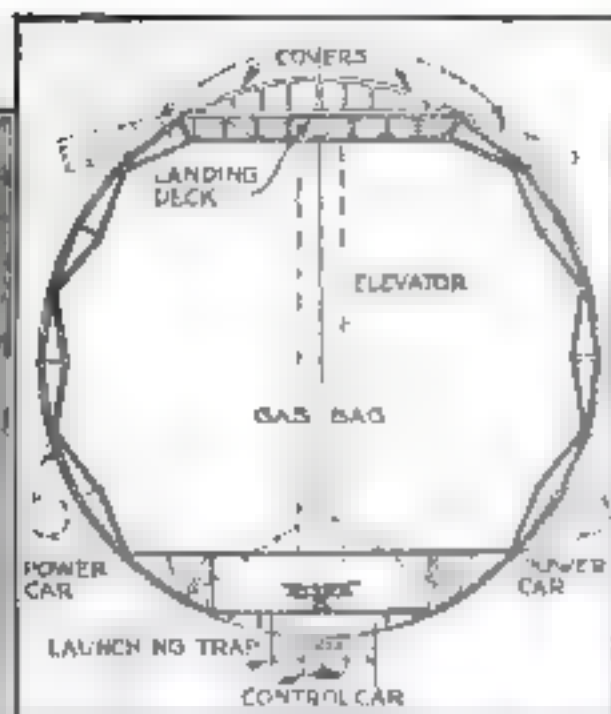
The following year, in the summer of 1920, these experiments were carried further by the British.

The R-33, a sister ship of the one that made a round trip from England to the United States in 1919, carried out experiments in releasing, carrying, and picking up an airplane by means of a



This towering mooring mast, has been constructed recently at Lakehurst, N. J., to anchor the first American-made dirigible the ZR-1

A Dreadnaught of the Clouds



Our artist's conception of the aerial war-ship of tomorrow, described by Admiral Moffett. Diagram shows cross section

cable let down from the airship. These tests were similar to those carried on at Rockaway the previous summer, but were more extensive.

The plane, a Sopwith Camel, was fitted with a bridle terminating in a ring that extended above the top wing of the plane two or three feet. When the airship picked up the plane, the speeds of the two were approximately the same and it was a simple matter to engage the ring on the plane with the hook at the end of the cable. The plane was released by tripping the hook and the pilot dived, started his motor and flew away.

Until now one hazard in airship operation always has stalked like a specter at the heels of this development. Hydrogen-inflated ships carry with them the ever-present danger of fire. Many aerial disasters have been traceable to this.

The United States, possessing as it does

the only extensive helium supply in the world, is particularly favored by nature. Helium, an inert gas, is not inflammable. It has but little less than the buoyancy of hydrogen and can be produced at a cost which, though higher than that of hydrogen, is inconsequential compared with the safety and dependability gained.

We Must Conserve Helium Supply

However, we cannot afford to be as prodigal with this gift of nature as we have been with others. A well considered program of conservation of this valuable product is essential to our national welfare, from a commercial standpoint as well as from that of national defense.

The helium airship will make this form of travel safe to a degree never before possible. It will insure low insurance rates on merchandises carried by airships.

From a military point of view, helium has placed a new complexion on the airship-airplane controversy. The airship filled with helium and defended by guns and airplanes, will be in effect a battleship with the sky as a limit. As the battleship is subdivided into watertight compartments, so the airship is made up of a number of gas cells. When a watertight compartment is punctured, the ship does not sink. This method of construction has saved ships even against the destructive effect of torpedo explosion. So the puncturing of a gas cell in the airship will not spell disaster. We may see these battleships of the air, riddled with shells, still fighting gallantly on to victory.

As a basis for the future of airship development in this country, the Navy, in constructing the ZR-1, is building wisely and well. America should be in a position to point the way to the world.

New Combination Tool Is a Mechanical Friend



A COMBINATION tool, of remarkable utility, consists simply of a steel bar hooked at one end, with a small hammer-head projection. It serves either as a nail puller, hammer, chisel, or crowbar.

Nail puller, hammer, and crowbar

Five-Ounce Pull Lifts Ton with New Chain Hoist

THE motor-driven chain hoist shown below will lift a ton at a five-ounce pull from the operator, whereas previous hoists have required a 90-pound pull.

The motor is controlled by a switch in the handle held by the operator. Turning on the current lifts the load. Pulling down on the handle winds the chain. Releasing the handle causes the load to stop, while the motor continues running.



How one man lifts a ton load

Inexpensive Dry Cleaning with Diminutive Plant

A MACHINE that makes possible a dry cleaning service without the expense of skilled labor and the employment of complicated machinery has been designed for use by tailoring shops, dry-goods houses, hotels, and cleaning shops.

The large brush shown in the center of the table revolves rapidly, loosening the dust from the fabric, while a strong draft draws the dust into a centrifugal type dust collector. The smaller brush is used for "spotting." The four plungers at the left end of the dash operate fluid containers. The dust collector is shown below the table.

Time Saved, Colds Avoided by This Built-In Mailbox

AN INGENUOUS accessory for the home is a newly invented, built-in mailbox. The box is so arranged that a letter, dropped into the slot on the outside, can be removed through a small door within the house. This will eliminate the necessity of going out of doors when the post-



man need no longer make a trip to the post office, even in inclement weather. Moreover, mail can be collected when one has risen late and is not dressed for the street.

Old and new types of mailbox

How Campers May Purify Unsafe Drinking Water

CAMPERS in districts where streams may be polluted will be relieved to learn that the Army Medical School at Washington, D. C., has evolved a handy method of purifying suspected water.

One or two drops of tincture of iodine will vanquish all the germs in a quart of unsafe water within from 20 to 30 minutes, according to this authority. Just shake the water container well. The greatly diluted iodine cannot be tasted.

"Permanent" Light Fixtures Are Easily Detachable

A NEW type of wall and ceiling socket for electric fixtures facilitates the removal, for cleaning, replacing, or interchanging, of those fixtures that we now term "permanent."

The socket consists of two parts, one fastened firmly



Adapted to two types of fixtures

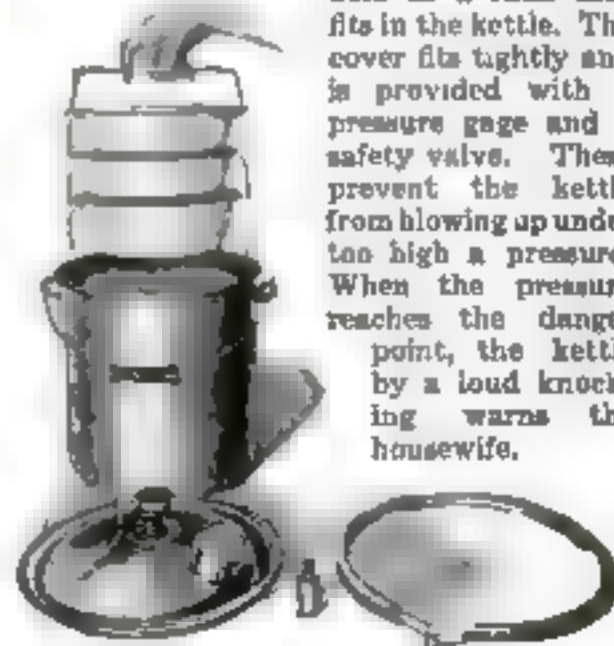
to the wall or ceiling and the other to the fixture. The plugs have large binding screws with which the fixture wires are connected. The fixture is suspended from a hook in the plug and is held tightly in place by a spring catch. Before the fixture can be removed, this catch must be sprung. This feature prevents the accidental falling of a bowl or wall light.

In homes equipped with this type of plug, lighting arrangements can be changed in a short time without the services of an electrician. For special occasions, extra lighting fixtures can be rented and installed as easily as one can screw in the lead to an electric iron or toaster.

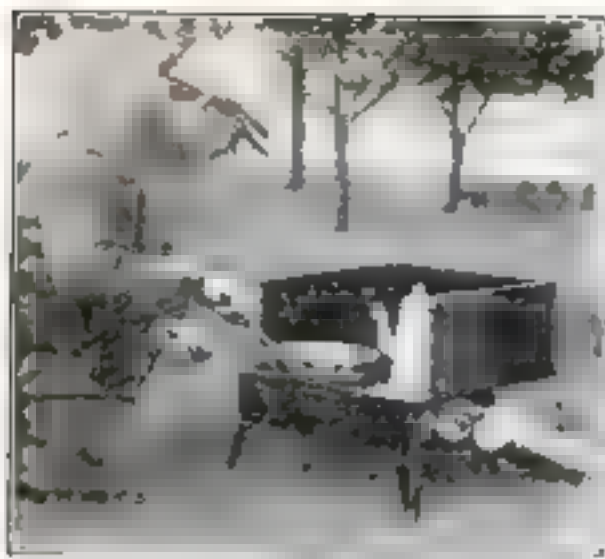
Automatic Pressure Kettle

MADE of enameled steel, a new pressure kettle that seals itself when the pressure within rises has been added to the list of new labor-saving utensils.

A stack of pans is held in a rack that fits in the kettle. The cover fits tightly and is provided with a pressure gage and a safety valve. These prevent the kettle from blowing up under too high a pressure. When the pressure reaches the danger point, the kettle by a loud knocking warns the housewife.



The parts of the pressure kettle



Folding Camp Stove Burns Gasoline from Car

HOME cooking comforts are provided the camper or motor tourist by the folding camp stove shown above. It burns gasoline, permitting the use of fuel extracted from the tank of the motor car.

A windshield, warming shelf, detachable pressed steel legs, and a two-burner iron grate are features of the stove, which may be folded to 4½ by 10½ by 19 inches for carrying. The entire outfit, including fuel tank, weighs only a few pounds.

Tiny Microscope Magnifies Object 225 Times

A SMALL pocket microscope, only four inches long and weighing but 15 ounces, recently perfected, is capable of magnifying an object 225 times its actual size. The instrument consists of a cy-



The pocket microscope extends as required

cal jaw and stand into which two other cylinders telescope. Beneath the lower lens is a hollow stage upon which the material to

be inspected is placed. Light reflected from a concave mirror underneath, illuminates the material. When completely closed, the degree of magnification is 50 times.

To increase this, it is necessary only to pull out either of the two cylinders to a point where a scale indicates the desired number. By pulling out both as far as they will go, an object is magnified 225 times. If the lower cylinder is removed, this is cut in half, thus giving a magnification of 25 times.

The instrument has been designed not only for use in laboratories, but as a field instrument for workers who find it necessary to observe minutely the condition of wood or metal with which they are working.

Rake-Mower Trims Edges of Lawn

PERSONS who mow their own lawns usually are compelled to use grass shears to supplement the work of their mowers in trimming the growth at the sides of buildings and fences or around trees or flower beds. Now a Michigan manufacturer has perfected an ingenious small mower, no larger than a rake, that will cut grass any place where a rake might be thrust.

The cutting is done by a set of eight sharp-edged cutting disks arranged along the front and operated by driving wheels at the rear. The driving wheels do not pass over the grass until it has been cut. The revolving disks will cut tall grass as well as short in a 16-inch swath.

Holding the handle in a natural position will cut the grass short enough for good appearance and the promotion of growth, yet will not permit the driving wheels or cutters to pick up twigs or small stones.

The new mower is silent in operation



This easily operated lawn trimmer has a series of eight revolving cutting disks (shown in inset) that shear the grass

and is light in weight. The blades are removable for sharpening or for the substitution of new ones. The rake is especially adaptable for trimming steep terraces.

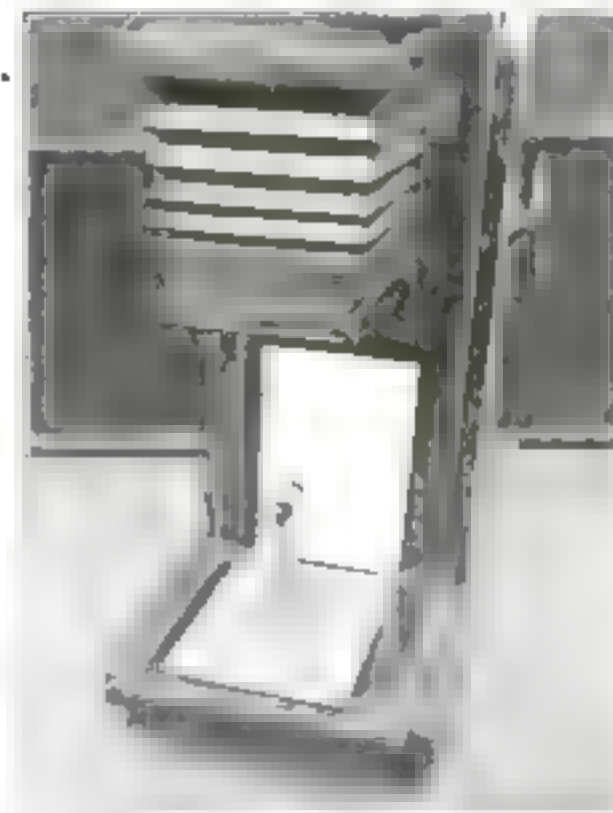
Supporting Small Objects before the Camera

GRAY backgrounds often are desirable in photographing small objects in the studio, but almost invariably the photographer resorts to the white background to obviate the many difficulties otherwise encountered. If the object is placed on a clear glass with the gray card underneath, he often gets reflections across the plate. If it is placed directly on the gray card, he gets disagreeable shadows and also an un-

pleasant mottled appearance, since each little corrugation in the cardboard stands out plainly in the photograph.

To avoid these difficulties there has been devised an invisible support method, as shown in the photograph. This is merely a nine-inch section of curtain rod, either soldered to a metal base or set firmly in a wooden one, which is pushed through the center of the cardboard desired for the background. A T-joint can be made to fit in the top end of the rod and this with the addition of a little modeling clay, will support any small object readily. If a long or heavy object is to be photographed, two such supports can be employed.

With this method there is no chance for reflections, and shadows are eliminated.



Photographing a small bottle on a gray background, using the invisible support

Wall Holder for Telephone Has Coin Box and Pad

THIS handy wall telephone holder, carries a little coin container to remind neighbors that telephone service costs money. A conveniently arranged pad may be used for notes or a ready reference directory of numbers.



The compact holder

[illegible]

1. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$
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INDIAN HISTORY

ANATOMY AND
ART



A T R I S A T E F T A T P H C O N E H o v p e r s o n
W h e n t h e W a t e r at d
c o u l d b e g i n t o g o d o w n b y c o m e s

Oilwell Fire Snuffed like Candle

Ingenious Cap Smothers Fatal Texas Blaze



The Hughes McKie oilwell fire near Corsicana, Tex., as seen from a distance. Thirteen men were killed and \$60,000 in oil was consumed.



C. T. Kinley (at left) and the suit used in recovering bodies of oil fire victims. The suit is made of several thicknesses of fireproof asbestos cloth.

MODERN invention rarely has been put to a more dramatic use than it was a few weeks ago, when a devastating fire, which had killed 13 men and had consumed more than \$20,000 worth of oil a day for three days, was extinguished by a giant candle snuffer devised for the emergency by an oilwell foreman.

This was the first time in the history of oilwell drilling that a burning oilwell was capped so successfully as to extinguish the fire.

The fire broke out at the Hughes-McKie well near Corsicana, Tex. So fierce were the flames, and so suddenly did they burst forth, that 13 workmen were burned to death before they could flee. For the next three days and nights more than 100 workmen, wearing special asbestos suits, labored unceasingly to recover the charred bones of their comrades and to extinguish the fire. Just when there seemed no hope of halting the fire before the entire capacity of the well should be consumed, D. L. Kelly, trouble shooter for the J. K. Hughes Company, appeared with the request that he be permitted to try his snuffer. For months he had been working on this invention, and had rushed it to completion after the Hughes-McKie fire started.

Kelly's invention is a huge cap supported by an iron tripod, from which it is swung on chains. Leading from the cap is a perpendicular pipe 10 inches in diameter and eight feet high, and a smaller lateral pipe forming

a T-joint with the main pipe. In the lateral pipe, at this joint, is a gate valve. A second gate valve is located near the top of the main pipe.

The entire device was hauled by an endless tread tractor to the burning well, where the tripod was erected. With the assistance of eight men, Kelly swung the cap over the mouth of the well, dropped it into place and made it practically airtight by means of a casing of sheet metal. Then the gate



Above: The well burning at its greatest intensity. This great column of flame and smoke finally was snuffed out by the ingenious capping mechanism, shown at the left, with its inventor, D. L. Kelly. Closing of the upper valve smothered the flames.

valve high in the main pipe was closed slowly, completely shutting off oxygen from the oil and smothering the flames.

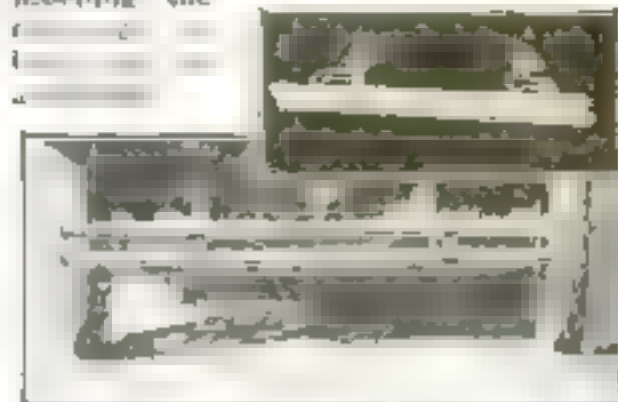
At the same moment the valve in the lateral pipe was opened, permitting unburned oil and gas under pressure to escape through this pipe, which emptied into a pit more than 100 feet away. Almost the instant the valve on the cap was closed the fire flickered out.

Repairs to the burned well are now under way, and it is expected its operation will be resumed shortly. Oil men of the Texas and other districts have shown much interest in Kelly's device since its successful demonstration. In fact, its inventor expects it will be added to the equipment of every oilfield as a protection against the greatest menace of the industry—fire.

Rubber Bumper Absorbs Jolts in Collision

THE chance of serious accident or disaster from bumping into any obstacle is said to have been lessened greatly by a new rubber bumper for automobiles recently put on the market. It is made of high-carbon steel tubing, coated with rubber of the kind used in the treads of tires, and it is attached to the automobile by strong U-shaped springs.

The hollow steel provides strength, while the rubber coating softens the impact, lessening the



The rubber bumper, attached with springs.



The camera of the memory. Through our eyes we register indelible impressions which the mind files away

Are You Using All of Your Brains?

An Article on Memory—and How to Improve It

By James J. Walsh,
M.D., Ph.D.

*Professor of Physiological
Psychology, Cathedral
College, New York City*

A FEW weeks ago the New York newspapers, in reporting a trial in which a noted criminal lawyer appeared as counsel for the defense, commented on the remarkable feats of memory which he performed many times during the closing days of the trial. Although he had made no notes at any time during the trial, he was able to repeat, word for word, just as they had been uttered by the witnesses, lengthy pieces of testimony that had been given days before.

What he repeated was not merely the gist of what had been said. It was the exact, verbatim testimony. His feat of memory won the case for the lawyer and saved his client from prison.

Amazing though this may seem to persons who have difficulty recalling names, addresses, and telephone numbers, actually it is no unique performance. Successful men almost invariably have retentive memories—storehouses of facts, assembled in order and properly indexed so that they may be found easily and put into use when needed.

Washington and Napoleon are said to have known thousands of men in their armies by name. Theodore Roosevelt has been credited with having remembered everything he ever read. Abraham Lincoln had at his fingers' ends every fact he ever learned. Pascal, the great scientist, could repeat the entire Bible. Shakespeare had a vocabulary of 15,000 words, Milton of some 10,000. Memory is nearly always an attribute of the great, for, as Bacon sums it up, "All knowledge is but remembrance."

And yet a good memory is not the exclusive possession of great men. Thousands of people in ordinary walks of life hold in their minds vast collections of facts of various sorts which they can produce at any time they wish. The telephone operator in the office of a large corporation will remember hundreds of telephone numbers. The clerk at the information desk in the office of a great public utility company in downtown New York City, can tell you instantly the number of the room in which any of the company's 3000 employees is to be found. A hotel manager in the Middle



In remembering a flower, such as the new pure white amaryllis (at left, named for Mrs. Warren G. Harding), we associate the name with the senses of sight and smell, which fix it firmly in our minds.

Eight Rules for Memory

HERE are eight simple rules which, Doctor Walsh says, should help you to train your memory.

1. Learn to concentrate.
2. Use as many senses as possible in obtaining impressions of an object.
3. Develop, by patient, systematic exercise, the faculties that seem to be weak.
4. Try to make your first impressions of an object permanent.
5. Revive your impressions frequently. After a vacation actors must rehearse roles in which they have appeared many times.
6. Have confidence in your memory. Don't rely too much on pencilled notes or on the memories of others.
7. Establish as many associations as possible for your impressions. In attempting to remember a fact, satisfy yourself as to what it is, whence it comes, where, when, how, and why it was made, and whither it is going.
8. Make your memory training practical and useful. A telephone operator, for example, might use her time better in committing telephone numbers to memory than in memorizing English verse.

West can greet by name any one of the thousands of persons who have registered in the hotel since he has been in charge. An office boy on a Chicago newspaper knows *virtually* every street in the city by location and name, and has on the tip of his tongue a vast fund of other information about the city—the locations and numbers of fire alarm boxes, fire houses, and police stations, the

street numbers of important buildings.

All of us cannot become Shakespeares, or Pascals, or Napoleons, but by systematic, intelligent exercise we can develop our memories so that they will be of real value to us in our contact with the world.

The training of the memory must be undertaken with the idea of aiding nature, not compelling her to alter her process of recalling past impressions to the mind. An example probably will aid me in explaining Nature's method of actuating the memory.

You see on your desk pad a brief note—possibly only a name, an address, or a single word. It recalls to you instantly a business engagement. The train of thought by which you connected the engagement with the entry on your pad, was started voluntarily. This voluntary action of the memory is called recollection.

You take a streetcar to keep the engagement. While riding on the car, you suddenly find yourself thinking of some event of your boyhood. The thought apparently has just "popped into your mind" from nowhere. This involuntary manifestation of memory is called remembrance.

Actually, there was no difference at all between these two mental processes. You may not have been aware of it, but something occurred while you were riding on that car to make you remember the incident that seemed to enter your mind from nowhere. A man sitting opposite you may have been wearing a suit of a peculiar shade of brown, which recalled a suit worn by some actor in the event which you thought you had forgotten. You may have heard a railroad whistle that



A child usually remembers a rebra as a striped horse and a giraffe as a horse with a long neck. Thus thinking in pictures and associating new impressions with old is invaluable to memory in after life, says Doctor Walsh

recalled to you travel on trains, distant places, your boyhood home, the friends of your youth and at last the event that "popped into your mind." The train of thought occupied less than a second. You were not conscious of the intermediate steps, but they were there just the same.

You can see, then, how recollection and remembrance may be considered as the same process. This knowledge can aid us in increasing the powers of our memories.

Memory Never Relinquishes a Fact

Past events and impressions are stored up in what would seem to be various layers of our memory which, as recent observation demonstrates, never entirely relinquishes any fact that they receive. In other words, we never completely forget anything we have learned. Our problem, then, is to train our active mind to reproduce for us any desired fact at our will. That this can be accomplished has been proved conclusively many, many times. It is done through what is known as the law of association, which is the foundation of all systems of memory training. We must learn to associate facts that we know with the facts we are attempting to commit to memory, so that the recollection of one fact invariably will lead to the remembrance of the other.

Doggerel is useful in memory training, for rhyme and rhythm stick in the mind. Rhythm is especially applicable in remembering telephone numbers and names.

The first thing to be cultivated by a person who desires to improve his memory is the habit of attention. "Attention," Lowell says, "is the stuff that memory is made of, and genius is accumulated memory." Therefore, as a first step, learn to concentrate.

Perhaps you say you cannot remember faces, but if that is true, it is because you are not sufficiently interested in the new people you meet.

A Memory Feat

Henry Clay once called by name a man whom he had seen for a single day in a jury box 20 years before, despite the fact that an accident had disfigured the man's countenance in the interim. The man's profile had remained unchanged, and Clay had trained himself to remember faces through their dominating characteristics.

You can do much the same thing. Catalog in your mind the various types of faces—round, oval, long, bony,—and the various types of eyes, noses, chins, mouths, foreheads, and jaws; then fit each new face you see into its proper type and make mental note of the features in which it differs from other faces. Try to find some resemblance

between that face and the face of some one you know well. Leonardo da Vinci drew sketches of all possible faces and numbered them. Possibly you cannot do that, but you can make mental sketches of the faces you see and classify them according to their types.

In seeking to remember facts, think in pictures. A child remembers a zebra as a striped horse, and a giraffe as a long-

number—picture them in blue electric lights if that will make the picture more vivid. Then get the rhythm on the successive numerals fixed in your ears. The telephone number "Main eight six hundred" has just as definite a rhythm as the first line of the "Star Spangled Banner."

If remembering numbers is your chief difficulty, do simple sums in arithmetic as a pastime, to accustom yourself to dealing with numbers. An acquaintance of mine cured himself of the unfortunate habit of forgetting telephone numbers and addresses by a simple game with which he occupied himself when walking along the street.

An Exercise

He tried to commit to memory the numbers on the automobile license plates as the cars passed him. He varied this by trying to add up the numerals on each plate before the car was out of sight. A few months of that treatment cured him.

A similar cure may be practiced by persons who find difficulty in remembering words. Learn a few lines of verse each day. When you are riding on

street cars, commit to memory the text of the advertising cards.

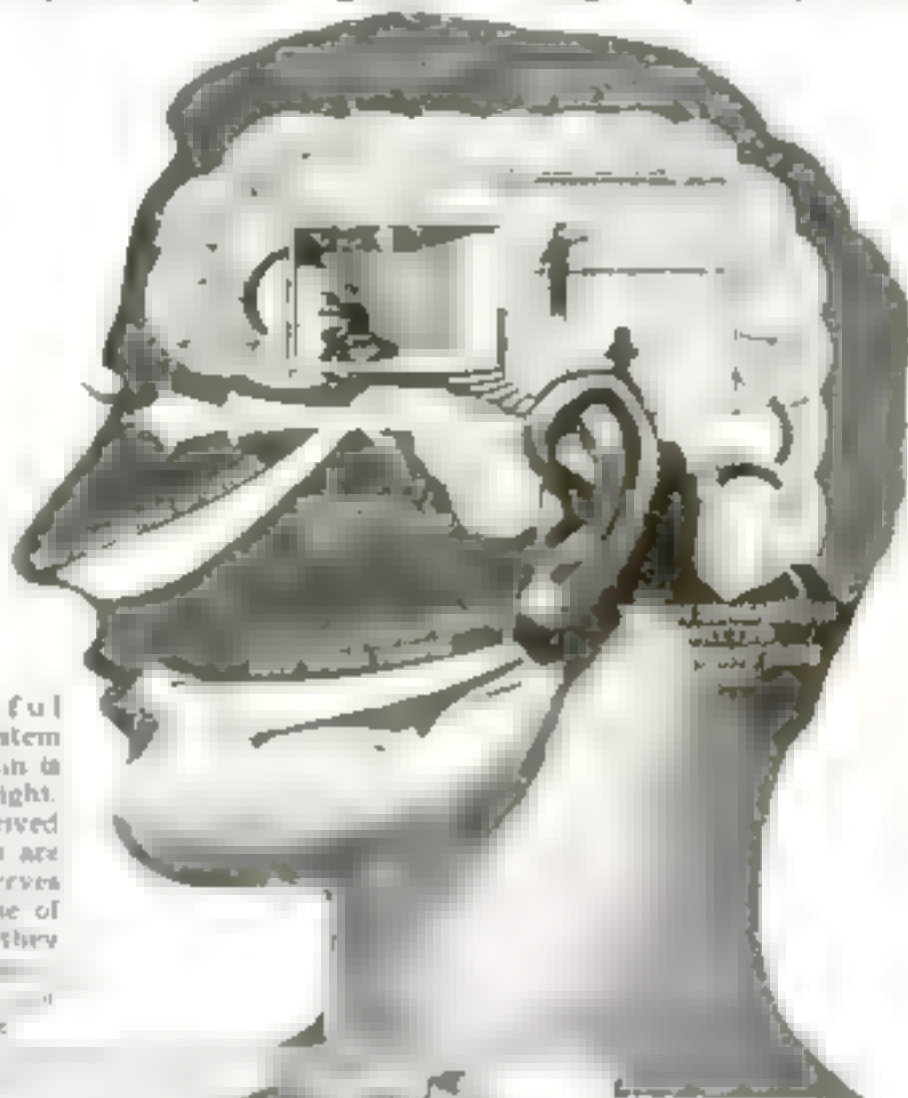
If you cannot remember names, attempt a classification of them similar to your classification of faces. If the names are of foreign origin, remember from what country they come. Fix their rhythm in your mind. Associate them with names that are similar. Names derived from such things as plants and animals suggest their own classifications. Other names may suggest pictures. In any case, spell the name to yourself and see the letters in your mind.

Is Genius "Accumulated Memory"?

The only method of remembering music that I know consists of hearing the music repeated many times. Chorus numbers on the stage are drummed into the minds of the performers by frequent repetition. Trained musicians, of course, can learn music simply by reading notes, as you would learn poetry. Josef Hofmann, the famous pianist, once learned a difficult and lengthy concerto from the notes during a short railway journey. A few hours later he played it at a public performance for the first time in his life entirely from memory. Once when the orchestral score for the "Midsummer Night's Dream" overture had been misplaced before a concert in London, the great Mendelssohn prepared the entire score from memory.

Geniuses such as these developed remarkable memories not only through tireless training, but largely through reliance on their memories. Early in their careers they learned to use their brains—all of them.

The wonderful memory filing system of the human brain is illustrated at the right. Impressions received by the five senses are registered by nerves in a clearing house of the mind where they are filed away for future use.



How a modern vocational bureau tests the memory by means of lettered cards and building blocks

necked horse. Try to bring every possible faculty and sense to bear on the storing up of a fact in your memory. You can use your sight and hearing always, your taste, feeling, and smell frequently. If you want to remember a number, picture in your mind the numerals that make up that

© Keystone

Baby's Canvas Bathtub Lightens Work

UNUSUALLY useful for the modern mother is this combination canvas bathtub and dressing table for the baby. It is designed to fit within the ordinary bathtub, and is supported by the sides of the tub. Not only is it sanitary for the baby because of a continuous flow of clean water, but it provides comfort for both mother and child.

After the large bathtub has been filled, the baby's tub is fitted in place and is ready for use. The infant nestles comfortably in a soft canvas bag that conforms to its body, while the mother, seated on a stool beside the tub, administers the bath.

Openings at the corners of the small tub allow free flow of water in and out, thereby assuring cleanliness and uniform temperature. The entire outfit is extremely light and can be carried easily from place to



After the bath the hinged cover serves as dressing table

place. It relieves the mother of tiresome bending and stooping and of carrying water for the bath.

The bathing bag dries almost instantly after water is removed from the bathtub. It is equipped with a hinged dressing table made of heavy canvas that covers the tub after the bath, and which, covered with a bath towel, makes a convenient place to lay the baby while he is being dressed.

Portable Radio Set Has no Aerial nor Ground

A PORTABLE radio set which, it is claimed, uses no ground and no aerial, is here shown. It is said to have picked up broadcasting stations 100 miles distant. A secret type of circuit using one amplifying tube, is the explanation given for the remarkable performance.

The photograph shows Miss Helen Conroy, of Brooklyn, N. Y., listening in during her lunch hour at City Hall Park.

Listening in with new portable receiving set, carried in a small case



Sheet-Music Pages Turned by Foot Pressure

ONE of the recent inventions is an automatic sheet-music turner, adapted to all sizes of pages. The sheets are engaged by clips of fine wire, and are turned when pressure is exerted on a pedal.



Pressure on pedal turns the pages

WHO are the world's ten greatest scientists?

From the whole field of science and from all the pages of history which ten men stand out clearly above the thousands who have done great things, and why?

POPULAR SCIENCE MONTHLY put this question to the British scientist who has done perhaps more than any other one man in modern times to put the facts of science within the reach of the average man and woman—to J. Arthur Thomson, Regius Professor of Natural History in the University of Aberdeen and author of the tremendously popular work, "The Outline of Science."

In our next month's issue we will announce Professor Thomson's selections. He will tell in his own fascinating way why he has placed the names of these scientists in the list of the world's ten greatest.

Safety Platform Designed for Washing Windows

A NOVEL hanging platform that enables a person to wash the outside of upper-story windows in comfort and safety has been invented by James C. Brewster of Fort Madison, Ia. The device consists of a stand and cage formed of iron bars, with hooks or hangers that extend across the windowsill and engage the portion of the windowsill within the room.

Diagonal brace bars that are a part of the cage have downwardly curved ends that rest on the outer horizontal portion of the sill and function to hold the cage and stand level while it is occupied by the person washing the window.

The hooks holding the cage to the windowsill are made in two sections, hinged together. This makes it easy to fasten the platform in place or to remove it when the work is completed.

The inventor declares the device is as safe as a kitchen floor.



Single Lamp Varies Colors on Advertising Signs

TO PRODUCE changes in color in the illumination of advertising signs, an Indianapolis inventor has devised the electric lantern shown here.

Hitherto, color changes in illuminated signs were effected by the employment of many electric lamps of various colors. With this lantern, the effect is produced by revolving glass plates of different colors. These plates are rotated about a single lamp by means of an electric motor that is noiseless and self-lubricating and that requires no further attention once it is installed.



Glass plates of various colors are rotated about the lamp by a noiseless electric motor

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

World's First Aerial Bicycle Flies

AN AERIAL bicycle, called the "cycleplane," driven only by foot-power applied by the pilot to an arrangement of pedals, recently achieved a short flight near Dayton, Ohio. It is said to be the first man-propelled flying device ever to lift itself from the ground.

This remarkable invention, the achievement of W. F. Gerhardt, aeronautical engineer at McCook Field, Dayton, Ohio, is 20 feet high and has seven tiers of wings, yet weighs only 98 pounds. It is admittedly crude in construction, being hastily built. Paper was used largely to cover the framework. The fuselage is torpedo-shaped and about 12 feet long.

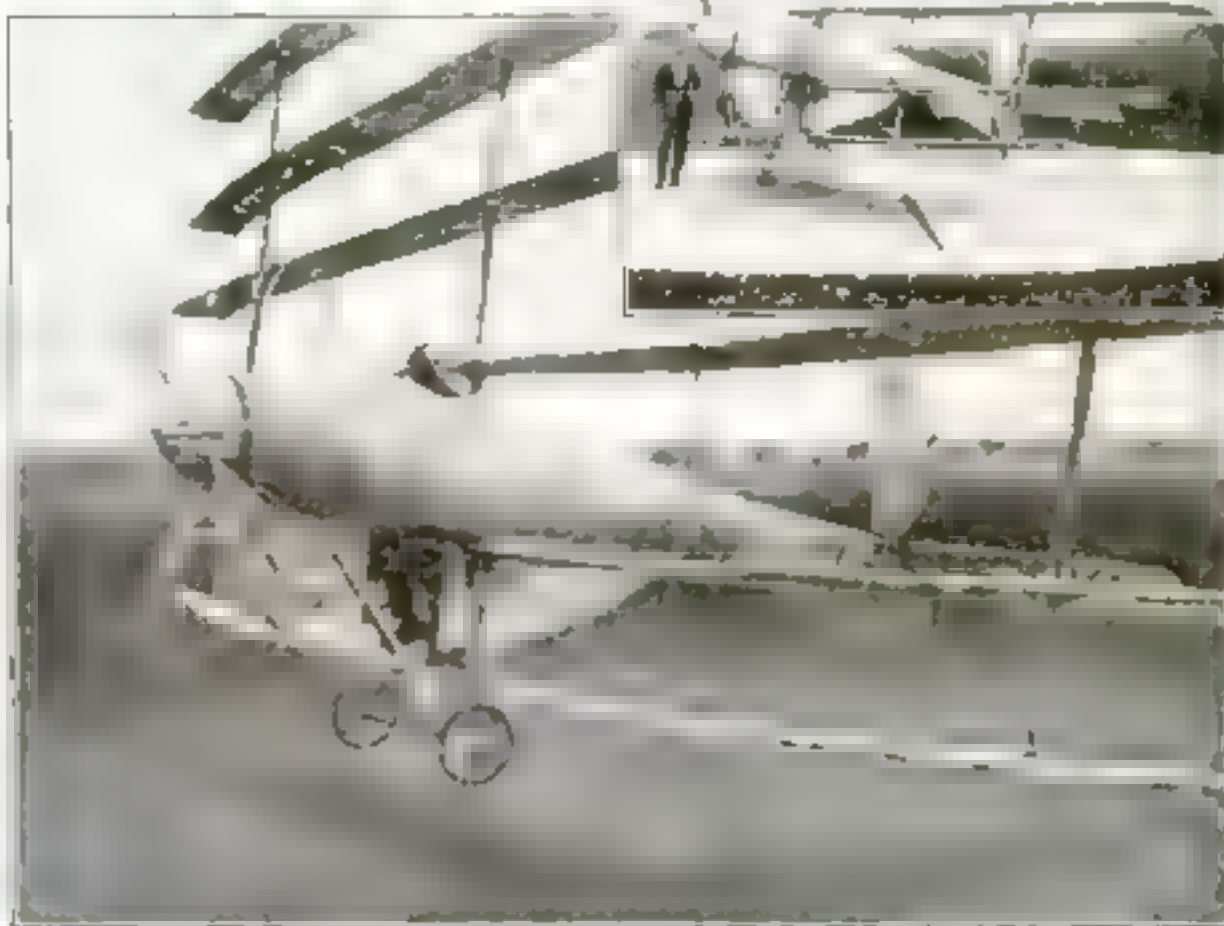
The pedals are connected with the propeller at the front by a shaft and gear arrangement. Complete control is centered in the "joystick," just in front of the pilot. It moves three ways, forward and backward to control the elevator and with a twisting movement to control the rudder.

In its test flight the machine traveled 20 feet and rose two feet from the ground.

The inventor is convinced that higher gearing, more careful construction and some modifications suggested by his trials will achieve a device capable of rising to comparatively great heights and attaining considerable speed. Future cycleplanes will be much smaller, he asserts.

Right: The 98-pound bike-flying machine with which the inventor W. F. Gerhardt, of Dayton, Ohio, recently made a short flight, using only foot power and pedals.

Below: An instant in what is said to have been the first flight ever accomplished by a man-powered flying machine. The inventor served as pilot and motor.



Six Fuses In One Socket

SIX fuses in the space commonly occupied by one is a recently devised convenience for the householder who forgets to keep a supply on hand. When one of the six fuses in the socket indicated by finger is blown out, a turn of the cap attached to it allows the current to pass through a new fuse.

The socket need not be removed.

A "Camera Filling Station"

THIS diminutive "camera filling station," built and displayed recently by C. L. Olds, of Lincoln, Neb., is made entirely of film spools except for four small nails holding together the roof signposts. Eight Christmas tree lights illuminated it in varied colors. A driveway of white crushed rock was used.



Built of spools and four nails

Ingenious Record Repeater Weighs Less than Ounce

A SIMPLE but ingenious phonograph record repeater, weighing less than one ounce, is a recent invention that makes home dancing without an orchestra more convenient and more enjoyable. It is said to be so simple that a child can attach it without difficulty or damage to the record or to the machine.

This device requires no adjusting. It merely is set in the center of the record,

This repeater does not touch playing surface



over the peg. It does not touch the playing surface of the record at any time, and its action is said to be so shockless and precise as not to endanger the record, needle, or tone arm. It is claimed that no appreciable pause intervenes between the end of the record and the start of the repetition.

As the needle reaches the end of the record, a movable arm, operating on a cam, picks up the tone arm and carries it, so quickly that the eye barely follows the movement, to the starting position. The arm is then returned to its place by a coil-spring. The length of your dance records now is measured by the capacity of your phonograph spring.



A Permanent or Temporary Paper Fastener

BUSINESS papers may be fastened together permanently or temporarily for working purposes by means of this improved fastener. The machine is adjusted simply by turning a little device with the forefinger, when one side of this device is turned up, the staple is pushed through the papers and clinched. When the other side is up, a temporary fastening is made.

Wood of Sawdust and Chalk

USING a mixture of 50 per cent sawdust with chalk and chemicals and subjecting it to extremely heavy pressure, a Norwegian inventor claims to have perfected an artificial wood possessing the toughness of real lumber.

The new substance is said to have the hardness of oak. It can be planed, sawed, bored, painted, and polished.

Our Silent Partners, the Plants

"The Story of Man and His World"

By E. E. Free, Ph.D., and D. T. MacDougal, Ph.D., LL.D.

EVERY human being is a parasite. Whether we like it or not, we must live upon the labor of others. These others are the plants.

Plants supply all the food in the world. They can support themselves by absorbing non-living substances like water salts from the soil, and gases from the air. We animals cannot do this. We must have more complicated foods, things like fruits or tubers or the bodies of plants, substances like starch or sugar that plants have manufactured, or the flesh of other animals who themselves have lived, in the last analysis, on vegetable products.

If all the animals in the world were wiped out by some cosmic cataclysm, life would still go on. Plants would remain and animal life undoubtedly could be developed again. But if all the plants died, life would disappear. We animals, deprived of the plant hosts on which we feed, would soon starve and the world would be as lifeless as in the beginning.

One Common Ancestor

Both plants and animals are descended, as we saw in the first chapter of this series, from the same creatures, from those little living slime specks on the ancient seashore, which were, we believe, the first form of life on earth. This was perhaps a billion years ago or more. Soon the specks diverged, you remember, into two groups. Some of them learned how to move themselves about and these became the ancestors of animals. Others learned how to make food for themselves out of non-living chemicals in the water, and these became the ancestors of plants. This marked the separation of the two great branches of the tree of life—the animal branch and the plant branch.

The later history of the animal branch we have already traced. We have seen how the descendants of the moving slime specks grew more and more complicated in form and bodily character, how they invented in turn the backbone and legs and warm blood and lungs to breathe with, and all the thousands of inventions that make up that culminating product of animal evolution—the body of man.

Meanwhile the plant branch has been inventive also. Plants have invented leaves, for instance, and strong stems like the trunks of trees, roots to take up water and food materials from the soil, fruits and seeds and flowers, and the thousands of bodily devices that modern plants possess.

The greatest of plant inventions was the first—how to make food of non-living materials. The secret was the use of the

IN THIS article, the eighth in *POPULAR SCIENCE MONTHLY*'s fascinating series on Evolution, Doctor Free, Fellow of the American Association for the Advancement of Science, carries us one gigantic step farther in his thrilling story of Nature's growth. This month the author has collaborated with Doctor MacDougal, well known for his valuable scientific work. Doctor MacDougal is Director of the Department of Botanical Research of the Carnegie Institution of Washington.

energy of sunlight. There still live in the sea vast numbers of tiny floating plants, billions of them in a bucketful of water, that still make food in about the same way, prob-

ably, as it was made by their first ancestors.

These plants contain a green substance, the same that gives the green color to all plants. This substance is able to take up some of the rays of sunlight and to use the energy from them to run its food-making machinery, just as a man-made factory uses electrical energy.

Sunlight furnishes, then, the power for the plant food factory. The raw materials come from the water. One of them is water itself, the other is a chemical compound called carbon dioxide. This compound is really a gas, the same gas that makes the bubbles in soda water. There is always a little of this carbon dioxide gas dissolved in sea water and this is taken out by the plant. It and water are built up chemically, by the energy of sunlight, into a simple kind of sugar, that is, into food.

Plants that have come ashore and learned to live in air still make food in the same way.

Every Garden a Sugar Mill

There is a lot of carbon dioxide gas in the air, and the leaves take up some of it. There is water, too, in the soil. The green leaf has the two necessary raw materials and sunlight provides the power.

The leaf makes sugar out of water and carbon dioxide and sunlight. This forms the food of the plant. In exactly the same way the process of sugar making is called photosynthesis. It is one of the oldest inventions of living matter and undoubtedly the most important.



Trapped by the Milkweed

Enlarged, shows how the flower of the milkweed catches and traps its prey.

legs. If the insect is strong enough to escape, this pollen is carried off to fertilize another flower.

A cluster of milkweed flowers seems like the one above is shown in life size in the right hand picture.



The next important invention in the line of plant evolution was that of a resistant body that could not easily be pulled apart. Before this, some of the single plant specks had taken to living together in groups, just as the animal specks had, and had produced thus the first many-celled plants. In the beginning, these aggregates of living cells were stuck together loosely, we may suppose, as the cells of some living water plants still are. Gradually the union between the cells became more permanent. The individual cells developed outer walls of a tough skin-like substance that we call cellulose. Some of them grew long and thin like threads, so that their tough walls held the mass of living cells together. These elongated cells gave the plant strength so that the movement of the water in currents or with the tide would not tear the body of the plant apart.

Just as the animals developed muscles and bones in order to move where they wanted to in spite of the currents, so the plants developed these thread-like cells so that they could sit still and not be torn apart when the water moved.

Most plants still have these thread cells. They hold together the long fronds of seaweed. They are the fibers that are in the wood of trees, fibers that we make into paper. The fibers of the flax plant give us linen thread and those of the hemp make rope for us. Some of the cells in the seed pod of the plant are the fibers of the cotton.

These three plant inventions were made while plants lived only in the sea. The land, as yet, was bare. But the sea was growing crowded. Food was scarce in it and there was a strong incentive for animals and plants alike to move out onto the shore.

This required, however, fundamental modifications of the body. To a living plant in the ocean the water and the carbon dioxide that it needed for food came to it automatically in the water that bathed it. In the air all this would be changed. New devices must be perfected to meet these changed conditions.

The plant inventors had to go to work again.

The advance of the plant army outward from the sea was slow and tentative. The oldest land plants that we know have been found, as fossils, in the rocks of Scotland. They are probably about 400,000,000 years old. Apparently they were shaped a good deal like the seaweeds from which we believe them to have sprung. Instead of true roots they had merely a bulbous enlargement buried in the soil, somewhat like the root of a present-day mushroom. They had no true leaves, only some rounded stems, that probably were green in color, that may have resembled superficially the stalks of asparagus you buy nowadays in the market.

These very ancient land plants had a ready-made, however, two important inventions. They had invented a protective covering, or skin, so that they would not dry out in the air as a seaweed would. They had devised, also, a



Plant Inventions

As shown by the peach

The peach leaves and the peach fruit are shown in the illustration. The peach fruit is shown in the foreground, and the leaves are shown in the background.

Seeds are the means used by the tree to propagate its kind, wrapped in a tempting fruit that is carried away by man and animals to other parts and eaten, after which the seed is dropped and later becomes a tree. At left: Cross section of a plant leaf, showing how the green substance, chlorophyll, manufactures sugar in living plants by absorbing sunlight and combining carbon dioxide and water.



Millions of tiny root hairs absorb water and food from the soil.

root of the first land plants developed projections and branches, and these grew millions of fine hairlike threads hanging on them, so that the plant had a root system.

stiff stem structure, built, as usual, out of elongated fiber cells, so that they could hold their stems upright and thus get more light for use in the manufacture of food.

In the next fifty or a hundred million years these two inventions developed into practically the modern form of plants—the familiar structure of leaves, branches and main stem. The utility of this structure is that it exposes as much surface as possible to the air and to light, both of which are necessary for the manufacture of food.

At the same time the original multiple

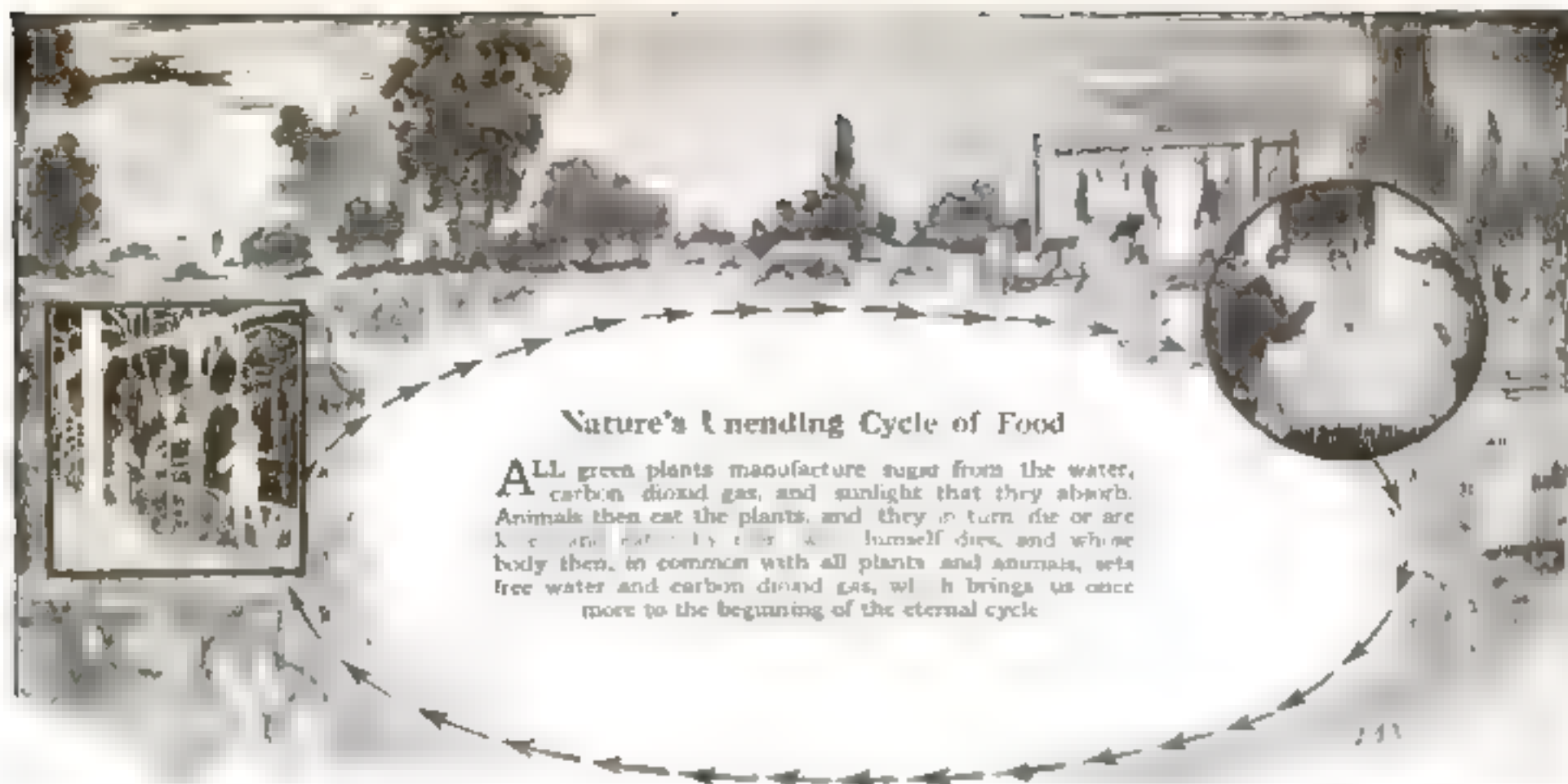
stem, a very large surface, available in the soil through which the plant could absorb the water that was no longer provided directly at the surface of the leaves. The impervious skin that was necessary to keep the plant from drying out developed many little microscopic holes, called stomata, through which the gases of the air could penetrate and provide the necessary carbon dioxide gas to the food-making machinery inside.

In the stems and branches there developed long tubes through which the water from the soil could rise (as what we call sap) to the place where it was needed in the leaves. All these changes were devices to expose the leaves (where food was made) to as much light as possible and to provide them with the two necessary raw materials—water and carbon dioxide gas.

It is interesting in passing to compare the way in which the animals met this same problem.

Flower in the crannied wall
I pluck you out of the crannies,
I hold you here—root and all, in my hand
Little flower—but if I could understand
What you are—root and all—and all in all
I should know what God and man is.

Tennyson



Nature's Unending Cycle of Food

ALL green plants manufacture sugar from the water, carbon dioxide gas, and sunlight that they absorb. Animals then eat the plants, and they in turn die or are killed and eaten by other animals. In this way, the cycle continues. In common with all plants and animals, sets free water and carbon dioxide gas, which brings us once more to the beginning of the eternal cycle.

Water and carbon dioxide continually are being taken into bodies of living creatures and set free

They, too, developed skins that would prevent drying, but they provided for the gas they need, namely, oxygen, by the device of inclosing in their bodies a little sea water, which became blood. Plants increased their surface (by branches and leaves) so that nearly all the matter of their bodies could come in close contact with the air itself. The animals, with some exceptions like the insects and the earthworms, provided for the forced circulation throughout the body of a fluid blood artificially charged in a special organ, the lungs, with the needed gases of the air.

Life's Marvelous Adjustments

Every creature, plant or animal, that lives on the land and breathes the air is living, really, under conditions to which it is unsuited and in surroundings for which it was not designed. We air-breathers manage to live at all only because of the astonishing inventive genius of life, just as men can live in the Arctic by the artificial expedient of heated houses, or down under the sea in invented submarines.

How successfully the plants managed to live on land and how long ago they did it, is indicated by the fact that about 300,000,000 years ago most of the earth was covered with luxuriant vegetation, the vegetation that produced our coal beds. There were few land animals then. Some insects existed and a few sluggish, crawling amphibians, half reptile, half fish. The land world in those days was a world of plants. Most of the animal life was still in the sea.

But at the end of the coal period the world felt, it seems, upon times of climatic disturbance. The weather, which had been warm and equable all over the earth, became variable. Some countries grew cold, others hot. The seasons, which had been much alike, became sharply different.

There were profound effects, of course, on the forms of life. The plants which had conquered successfully the difficulties of coming ashore had another ordeal, to face. How were they to survive the dryness of

a long and rainless summer? How could they escape being killed by the winter cold?

They met these difficulties in different ways; but the most successful solution, on the whole, was the invention of the seed. All the seed is, really, is a device to keep the plant alive during an unfavorable season, or, what is the same thing, to start a new plant of the same kind when conditions for life become more favorable.

Certain kinds of plants a good deal like modern ferns had already fallen into a habit of what is called the alternation of generations. One generation of such plants was quite different in appearance from the next one. The first generation, for instance, might be a small creeping weed that lived only a few days; the generation that grew from this weed might be a great tree that lived for many years. The third generation, in turn, would be like the first, and so on.

Out of this habit developed the device of seeds. One of the generations, usually the smaller one of the two, came to live its life, not freely, but as a parasite on the other generation. Then this parasitic plantlet, really the dwindling remnant of the alternative generation, became inclosed in a sort of a case or coat and did not

live in the open at all. That is, it became a seed.

If you carefully cut open a bean or pea seed, or any seed, for that matter, that is large enough so that you can see what is inside it, you will notice that it contains a little whitish thing that is really a tiny plant.

When the seed sprouts, it is this little plant that comes out and grows. Most seeds contain, also, some food to provide for this plantlet until it can grow large enough to feed itself. This food is the starchy or oily or "meaty" part of the seed. Cornmeal, for instance, is the food that was stored up in the seeds for the little plants. The plants themselves are the "germs" that the miller takes out and throws away.

Plants Die; Seeds Replace Them

When the cold winters of the years following the coal period clamped down their ice and snow on the land, the large plants died.

But these plants had left seeds behind them. The seeds could stand the cold. In the spring they were still alive, and as soon as the weather was warm enough, they woke up and started all over again.

The animals, of course, had to meet this same problem of surviving the winter. Some did so by developing the habit of hibernation or winter sleep, a habit which the ancestors of our frogs acquired at this time and which their descendants still possess. Another group of animals—the insects—met the problem in exactly the same way as the plants did, namely by making use of an alternation of generations. This is what the yearly change of grub to butterfly and butterfly to grub really is and this is why it was developed.

But this is not quite all of the story. It is never enough for life, it seems, merely to survive. It must expand, enter new realms, conquer more territory, just as plants and animals advanced out of the sea.

Now the plants, you notice, have handicaps against expansion on the land. (Turn to page 118)



How Nature makes potatoes—The sugar manufactured in the leaves is transported downward into the tubers and there converted into starch for storage.

A Lower Berth for Everybody, Is New Plan



PRESENT TYPE SLEEPING CAR



IMPROVED TYPE, AS DAY COACH

Above: Diagram contrasting the daytime arrangements of the old and new sleeping car designs. Right: How the new type seats are converted into beds



AS A SLEEPING CAR

SPACIOUSNESS and comfort both day and night, are provided in an ingenious new design for sleeping cars proposed by M. C. Krarup, consulting engineer. The illustration above shows two compartments of the car arranged for daytime use. The seat nearer the window is pivoted, allowing a range of positions. The fixed aisle seats double the day accommodations of the car. Twenty-four of these compartments can be contained in an ordinary sleeping car.

AT THE right: The same two compartments converted into sleeping berths. Note the spaciousness, allowing comfortable bedroom, a personal wash basin and a large mirror. Bedding is stored in the lower portions of the chairs, and the mattress is produced by lowering the back cushion and extending the seat of the pivotal chair.

The compartments would be separated by partitions of material such as bakelite paper, which is stout and yet can be pulled down from oblique spring rollers in the ceiling. Two would be required for each compartment, one attaching to the pivotal chair and the other, slightly overlapping the first, hooked across the stationary aisle seat. The projecting portion of the aisle seat would be covered. The aisle curtains would resemble the usual drapes now used in sleeping cars.



This Coin-In-the-Slot Radio Is Parisian Innovation

THE penny-in-the-slot machines with ear tubes that had their habitat in depots, amusement parks, and hotel lobbies have, for the most part, disappeared.

With them have vanished the songs they emitted in squeaky jumbles of sound. But the idea they embodied lives today in this French radio machine, which is invading wherever Parisian crowds are.

In cafés, motion-picture theaters, hotel vestibules, steamship cabins, and many other public places, this coin-in-the-slot receiving apparatus is plucking melody from the ether and roins from the purse.

The coin connects the receiving apparatus for a limited time. A card beside the device tells the hours when music is available.

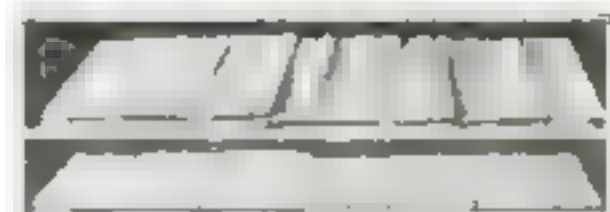
Revolving Sash Facilitates Window Cleaning

WINDOWS with double-hung sashes, that not only can be raised and lowered in the usual manner, but also swing completely around on horizontal pivots, have been designed recently to facilitate cleaning. When tilted at right angles to

their normal positions, the entire window space can be used for ventilation. The windows are made for any size of opening and may be installed in any house, old or new.

Tilting them at an angle assures draft-proof ventilation even on windy days.

Crimped Shingles Restored By U. S. Forestry Service



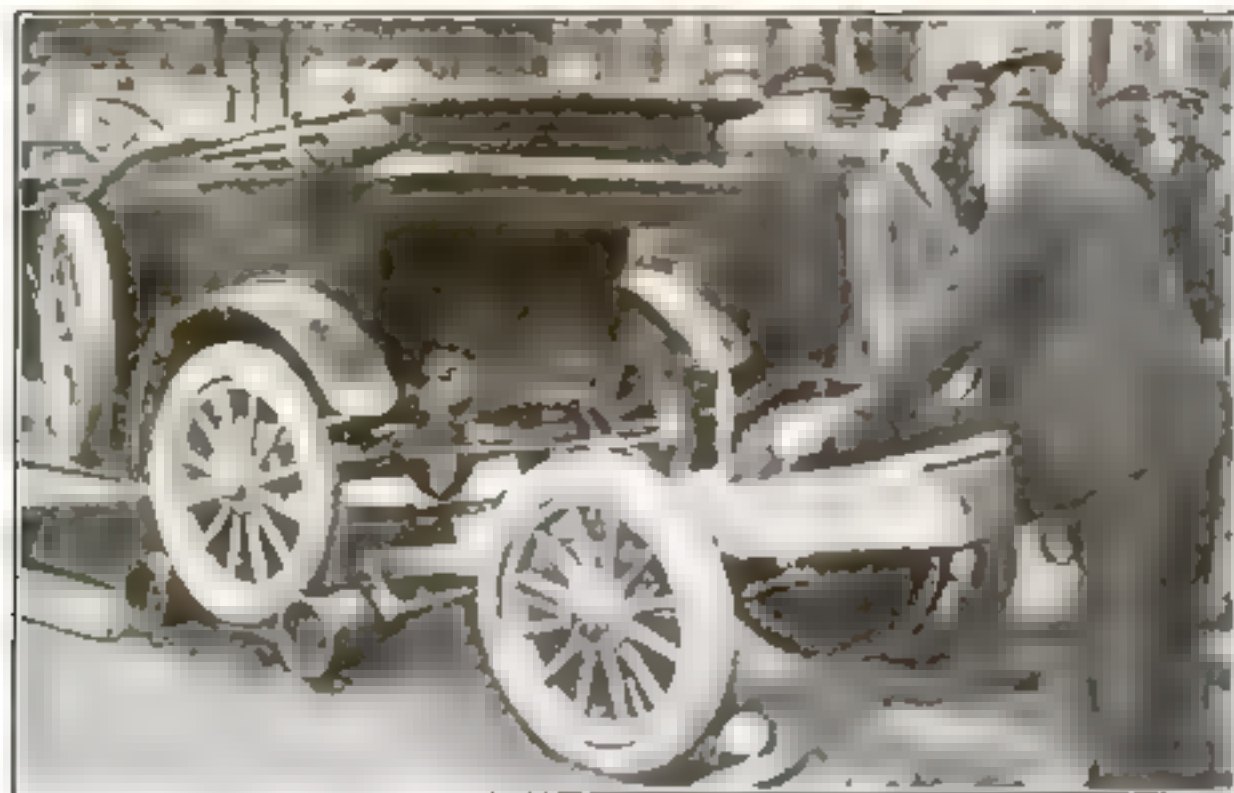
Cedar shingles before and after undergoing the new process

A METHOD whereby shingles of cedar and similar wood that have crimped in drying because of excessive moisture may be restored, has been announced by the United States Forestry Service. Since shingles thus damaged are worthless, the discovery promises some really valuable economies.

Crimping is due, it was found, to the collapse of the wood cells that contained the free water. If the shingles are subjected to live steam at boiler pressure for 20 hours and then dried in a kiln at a temperature of 160 degrees, with from 25 to 35 per cent humidity, the crimp disappears.



Safe, easy cleaning with swivel sashes



Auto Engine Serves as a Sawmill

THE "How My Car Serves Me" prize contest, announced in the September issue of POPULAR SCIENCE MONTHLY, has met with immediate response from our readers who own automobiles. Many of them have sent in letters and photographs describing novel uses to which they have put their cars.

All the way from Paris, France, comes an interesting contribution, an invention of M. G. Schoedlin. The photograph of his ingenious motor-car sawmill is reproduced above. With this saw, mounted on an inclined truck at the rear of the car, he has more than paid for his car. The device is driven by the two rear wheels of the automobile which rest on two friction rollers.

When the engine is started, the saw revolves with sufficient force to cut logs of the size ordinarily used for firewood.

Competition in the "How My Car Serves Me" contest closes September 20. For the best letter of not more than 400 words, accompanied by photographs or drawings, we offer these prizes: \$20, first prize; \$10, second prize; \$5, third prize. A number of the contributions will be published next month. Prize-winning letters will appear in the January issue.

Address Automobile Contest Editor, POPULAR SCIENCE MONTHLY, 235 West 39th Street, New York City. Each letter will be considered by a board of editors, whose decision will be final.



© Keystone

Baby Is Given Fresh Air in Window Cage

BABIES of flat and tenement dwellers, whose tiny lungs have been furred to breathe stale and overheated air, are offered relief by the recent English invention pictured above. A large metal grate is attached to the outside of the window by two stout iron poles. A baby basket can easily be lowered inside. If insects are likely to trouble the child, the grate can be screened.

Droplights Are Adjusted by Simple Arm Device

DROPLIGHTS that swing from the ceiling by flexible wires have always been difficult to adjust to heights and angles such that they throw a maximum amount of light on the proper spot. Any one who has used them in the study, the office, the workshop or the garage has probably been forced to change the height by knotting the cord and to swing the lamp from place to place by tying it with strings attached to walls, joists, desk legs and other places.

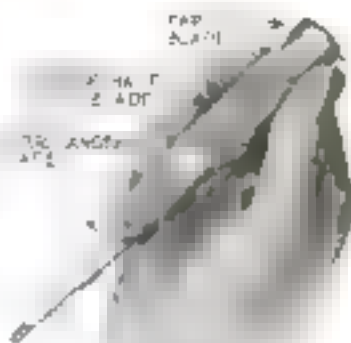
A St. Louis man has devised this simple attachment, which permits the droplight to be adjusted as desired. It is a pivoted arm to which the light may be fastened at any point. Swinging the arm up or down or from side to side causes rays to fall wherever desired. A movable clamp permits the arm to be placed wherever necessary.



The light adjuster aids in typesetting

Quick-Change Screwdriver Contains Three Blades

THE ingenious little tool shown here is called a "lightning-change magazine screwdriver." It has three sizes of blades, contained inside the handle and numbered 1, 2,



and 3, according to size. There are three corresponding numbers on the handle, and the blade desired is obtained for use by turning a cap, rotating the handle until the number corresponding to the number of the blade is up, then tipping the handle until the blade drops into place.

A turn of the cap locks the blade into the handle for use and holds it rigid. The blade springs back into the handle when the locking cap is turned in the opposite direction.

These Two-Piece Overalls Are Dustproof



This dust-proof overall suit, consisting of jacket and trousers is said to offer unusual freedom of movement

THIS work garment has all the appearance of the ordinary one-piece overall suit, but in reality it is a two-piece suit so fashioned as to be absolutely dustproof.

The suit consists of a jacket and trousers. The jacket has a waistband under which are tabs which button to the trousers. If the trousers wear out or are hopelessly torn, it is not necessary to discard the entire garment, as would be the case with the ordinary one-piece overall. It would be necessary merely to buy new trousers.

The garment when fastened together may be put on and taken off as a one-piece suit, and when buttoned it is dustproof. It has no bits, strings, double folds, buckles or catches to bulge and dangle, thus permitting greater freedom of action and making laundering easier.

Making Shoal Water Soundings with Light

AN ENGLISH inventor has devised a method of utilizing projected light to determine the depth of water through which a vessel is passing. The device is said to supply an accurate and satisfactory substitute for the time-worn operation of "heaving the lead" to make soundings in shallow water.

The apparatus consists of two parts. One of these is a projector, which, through a porthole in the bottom of the hull, throws a beam of light directly downward to the bed of the waters. The other part, called the "depth finder," is placed at another porthole some distance from the first in the bottom of the vessel in such a position that the beam of light may be observed plainly. In this manner the angle between the line of the beam and the observer's line of vision is recorded accurately.

How Depth Is Determined

Running perpendicularly from the chart-room is a tube connected with the depth finder. By an arrangement of mirrors the ray of light is reflected through this tube so that it can be observed continuously by the navigating officer. After the apparatus has recorded the angle between the light beam and the line of observation, a simple calculation determines the depth of water beneath the vessel with absolute accuracy.

The apparatus, of course, cannot be used in sounding the depths of the ocean, for it is impossible to project a ray of light powerful enough to penetrate to the bottom. But it is entirely efficient in rivers, and other shoal waters where frequent soundings are necessary to a vessel's safety.

Soundings can be taken with this instrument under any weather conditions and at any speed. The necessity for "slowing down," as with the prevailing method, is obviated. The only instance in which it could not be used would be in the rare event of the failure of the electric current.



How beam of light, projected downward, makes soundings. Depth is determined by mathematical calculations based on the angle formed by light beam and line of sight.

Gyroscopic Indicator Makes Night Flying Safe

PERILS of flying by night, or in clouds have been lessened by a new gyroscopic indicating instrument recently perfected by the United States Army Air Service at McCook Field, Ohio. It consists of two gyroscopes with axes at right angles to each other, and a glass tube resembling the bulb of a carpenter's level.

The first indicating gyroscope has its axis horizontal and parallel with the wings. A turning of the plane to the right causes the top of the rotating gyro to tip to the right, actuating a pointer that shows the amount which the plane has turned.

The pitch-indicating gyroscope also is mounted on a horizontal axis at right angles to the first. A downward pitch of the plane causes the registering end of the axis to move down, and the pointer shows on a scale the amount of dip at which the plane is descending.

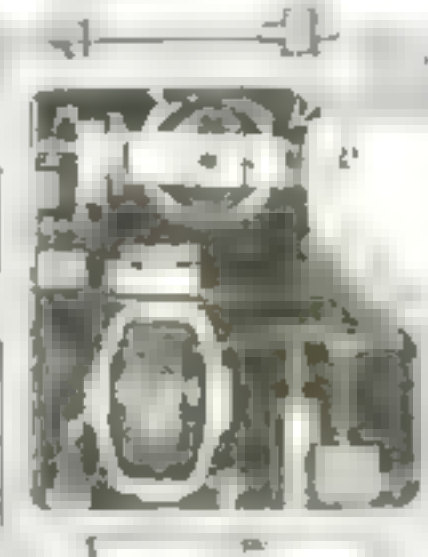
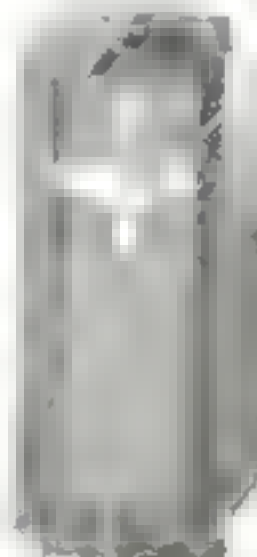
When the plane is moving horizontally, all scales

read zero, but as soon as one wing drops lower than the other, the ball within the gage glass moves to one side.

Both gyroscopes are turned by a jet of air that is shot against vanes formed in the rims of the wheels. This jet of air is produced by the suction of the wind.

BALL OFF CENTER INDICATES TILTING OF PLANE

GYROSCOPE TILTS WHEN PLANE



IF GYRO MOVES DOWN WHEN PLANE DIPS

On the face of the indicator (at left) pointers register turn and pitch, while a level indicates tilting of plane. At the right, interior of the device, showing the two gyroscopes.



Chicken Incubator Used in Cheesemaking

AN ORDINARY chicken incubator has been used with striking success to test milk in cheesemaking by J. L. Sammis, of the Wisconsin College of Agriculture, shown above with his testing apparatus.

Milk samples are placed in test tubes in the incubator and subjected to heat of a temperature favorable to the development of bacteria. The samples are tested, and the milk is accepted or rejected, according to its reaction to the heat.

Roof Railway Aids in Cornice Work



At the left the rail car way showing how car with counter weight and balanced ladder suspended over the edge of the building. Below, the moving ladder and at the right a view of the corner of the building.

TO FACILITATE the work of changing electric lamps for the cornice lights of the *Seattle Times*, of Seattle, Wash., a small railway on its roof was installed. The *Times* found that the many cornice lamps illuminating the building were difficult to replace, sometimes requiring 10 hours of labor. Other problems of work about the building were solved and as a result the railway was decided upon.

Steel tracks were laid on the roof running all around the building. On these tracks a three-wheeled bus-like car is used. On the inner side the car carries a 200-pound counterweight. The outer side supports a ladder designed to hang over the edge of the roof. At the bottom of this ladder is suspended a small raised platform on which the worker stands.

Standing on this platform the worker moves quickly from lamp to lamp, while helpers push the car along the track. Instead of the 10 hours formerly required to change the lights, the work is now done in two hours.

The amount of work saved and the



greater comfort and safety of the workman can be realized from the fact that formerly attention to the cornice lights meant 110 trips over the side of the building on a small ladder.



Spurned Corncob Rises to Dignity of Wood

YOU, who have thought of corn cobs only as holders provided by Nature from which you might nibble the sweet kernels, should be interested in the recent discovery by Professor Darling, of Miltiken University, Decatur, Ill., of a process by which 60 per cent of the cob can be manufactured into a substitute for wood. Professor Darling is shown above in his laboratory, making his synthetic wood.

The cob is ground to a flakey, fibrous pulp and, after being mixed with a suitable binder, is compressed by a powerful hydraulic press.

The finished product can be whittled, glued, nailed, screwed, shaved, or turned on a lathe without danger of chipping. It will withstand a pressure of 10,000 pounds to the square inch. It can be stained and varnished like ordinary wood.

A Blowtorch that Solders and Brands

A COMBINATION soldering iron, blowtorch, and branding iron, which is self-heating, of light weight, and little more than a foot in length over all, has been developed by an Illinois manufacturer.

Gasoline is used as fuel, and is carried from the large cylinder by cotton wicking



to the flame tube through which it is fed by a patented needle valve and vaporized. A special alloy steel tube connects the fuel tank with the burner in order to keep the tank cool at all times.

The device may be adapted to any of its three uses by a simple adjustment. The fuel feeding is said to be so arranged as to insure safety to the user.

Handwriting Telegraphed

TELEGRAPHIC transmission of written script—1453 words in six minutes—was accomplished recently by a new French invention. The handwriting was sent from Lyons to Malmaison, near Paris. Ordinary transmission of such a message by telegraph would have required 25 minutes. The promoters of the new device plan to make it available soon for the use of the French public.

Air Cushion Seats Designed for Motor Buses

OMBIBUSES with seats that rest on pneumatic shock absorbers promise to solve one of today's greatest passenger transportation problems in rural and suburban districts. Country roads are not always in first class condition, and to protect the passengers from painful bumps and shakings it is necessary to use pneumatic tires on the wheels of a vehicle. But such tires are costly and, owing to the bad condition of the roads, have a brief life.

A new type of seat, recently placed on the market, makes it possible to employ solid tires without exposing passengers to the discomfort of shocks, and perhaps injury, when traveling over rough roads. According to the width of the seats, they rest upon one or two valve-controlled pneumatic shock absorbers acting through springs. The cushions consist of two telescoping

metal cylinders, carefully machined so that they fit practically airtight when lubricated. They are said to be so efficient that passengers may read without undue eye strain.



Interior of motor bus equipped with pneumatic shock absorbers, as shown at the right. An air cushion in cushioning a spring absorbs the jolts over rough roads.



Bicycle Searchlight Made with a Flashlight

A BRACKET that permits an ordinary pocket flashlight to be utilized as a searchlight by a bicyclist has been invented by Clarence E. Graves, of Hammond, Ind. It is a strip of sheet metal fitting the circumference of the flash lamp, to which it is secured by a bolt and thumb nut. It is fastened to the handlebar by one of the bolts that engage the bar at the head of the bicycle.

Adjustable Window Shelf for Flower Pots

FLOWER lovers who are city dwellers will warm to "Betsey Bobbit." The young lady is an attractive adjustable shelf, which makes it possible to have a

flower pot on even the narrowest window sill.

The device is of metal, sturdy built and capable of supporting a pot weighing 20 pounds. It hooks over the sill, between the sash and the sill, and does not interfere with raising or lowering the window. The retaining strip gives the strength necessary to support pots heavier than 12 pounds. It is fastened to the apron or facing of the win-

dow by a few tacks and the slanting piece then is engaged in it.

The invention is easily slipped into place, and its inner support, made attractive by a hand-painted picture of an old-fashioned girl, lends itself well to any home interior.

Gracing bare windows with flowers gives charm to the dingiest and least inviting of exteriors. And flowers in windows, never sun-hungry, always thrive.

Nerve Splicing is Achieved

NERVE splicing, said to be the most delicate of surgical operations, is one of the latest achievements of curative science. Nerves from animals may be used to restore health and activity to human muscles and other body parts suffering from nerve loss or disease.

A Mobile New Pump with Many Uses

AN ENGINE-DRIVEN double-cylinder pump, mounted on automobile wheels, so that it may be moved from place to place by automobile, motorcycle, or motor truck, or drawn by hand, has been perfected by a Pennsylvania manufacturer. The device is said to adapt itself to a variety of uses.

It may be used for any purpose for which a pump is necessary, in construction work, in repair work, or in irrigation. Its mobility adapts it for general pumping utility about a farm or industrial plant. It is, moreover, a particularly effective piece of fire-fighting apparatus. Industrial plants and small towns could find inexpensive fire protection in it.

The engine develops five horsepower, and the double cylinder assures a continuous stream. This stream can attain 10-20 gallons a minute. A single half-inch stream may be directed from a half-inch



This easily transported pump, with its capacity of 20 gallons a minute, can fight fires or empty flooded basements.

fire nozzle on a blaze at a considerable distance. For fires closer to the machine, two high-pressure streams may be used. The suction hose is adapted for quick and convenient use in lake, creek, well or in any flooded place.

The pump and engine are securely mounted on steel, thus permitting the device to be safely transported at high speed over rough roads. The apparatus weighs 1300 pounds, completely equipped.

Inventor Soars in a Ten-Pound Flying Device

INVENTING a 10-pound flying machine and then flying with it was the daring exploit performed recently by a German inventor, Dr. I. Seehaase, who is shown

here with his folded diminutive gravity-outwitter over his shoulder. The other picture shows the same device being handled in a high wind by attendants in preparation for a flight.



It is said to be the simplest device with which man can beat the wind. It is a sort of parachute, but it is not so constructed. It is said to be even when the wind dies or is aloft, since its parachute permits an easy descent.

Several successful flights are said to have been accomplished by the inventor, in spectacular tests in Germany.



Above, Doctor Seehaase carrying his 10-pound folded parachute kite. Below, attendants about to release the retaining ropes for a flight by the inventor.

Is a New Ice Age Coming?

Famous Polar Explorer Taking Radio into the Bleak Arctic

By Captain Donald B. MacMillan

When the following special article was received in the office of this magazine, the explorer already had embarked on his eighth expedition into the Arctic to determine, among other things, whether another Ice Age is beginning.

Captain MacMillan is preeminently fitted to discuss this fascinating question. He has missed only two of the last 15 years in the Arctic. In 1908 he voluntarily relinquished his position as a college professor to sail north with Peary on his memorable dash to the North Pole. His observations concerning the advance of the glaciers in the Far North, and the reasons offered by science, will interest every reader.

IT IS always of interest to me upon my departure for the Arctic regions (this is my eighth) to learn just what particular phase of our projected work appeals most especially to the public. This year it happens to be the possibility and the probability of another glacial period.

That subject is of great interest, but not more so than the subjects of terrestrial magnetism and atmospheric electricity, in both of which we hope to do good work under the direction of the Carnegie Institution of Washington. The latter is of especial interest just now in view of the tremendous wave of enthusiasm over radio.

We are going far beyond the Northern Lights, planning to winter at Cape Sabine, eleven degrees from the North Pole.

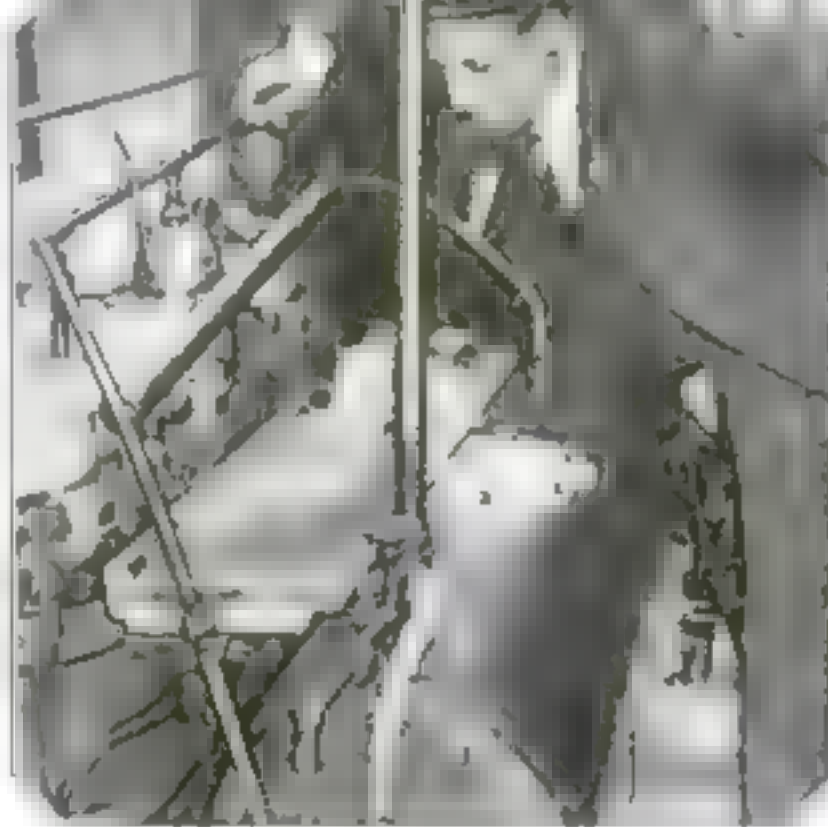
My auxiliary schooner, *Bowdoin*, especially built for arctic work, is equipped with a powerful sending and receiving wireless outfit. In our tests we have heard stations 2500 miles distant, and have communicated with stations in Virginia and the Far West, thus assuring success in this branch of our work if we can penetrate the auroral belt that encircles the globe at about 55 degrees north latitude.

On my last trip, when two degrees beyond the Arctic Circle, every night I heard distinctly the Arlington station at Washington, D. C., and this with a much inferior set than now installed in the *Bowdoin*.

It was the intention of our radio experts to use copper strips on the bottom of the



The *Bowdoin* frozen in during MacMillan's last Arctic trip in 1921.



Capt. Donald B. MacMillan tuning up the engine of the *Bowdoin* for his present trip to the Far North.



Captain MacMillan in his radio room on the *Bowdoin*, from which he will send messages from the Far North.

Bowdoin as a ground. We decided, however, that the 1700 steel plates on the bow with which we crush and ride over ice will serve the purpose equally as well.

All of our best and ablest geologists declare that we are at the close of a great glacial period when the northern part of North America was covered with 4,000,000 square miles of ice. The first great icefield was developed about 600,000 years ago. Since that time there are very good reasons for believing that we have had three more great glacial stages, each lasting 25,000 years, with interglacial stages averaging 125,000 years. What is the explanation of these climatic changes? Many and sound reasons have been advanced, among which are:

An increased degree of ellipticity (the oval shape) of the orbit of the earth,

A change in the obliquity of the elliptic.

A change in the position of the earth's axis.

A change in the thickness of the external crust or in the position of the fluid nucleus.

A change in the distribution of the land and sea.

A general elevation and subsidence of the surface of the earth.

Why Not another Ice Age?

Since we are absolutely certain that we have had four or more great glacial stages, no good and sufficient reasons can be advanced why we should not have others. The glaciers in the Alps are all retreating, those of the Chamonix Valley from one quarter to one half mile during the last 10 years. The glaciers of Alaska also are lessening in bulk. The Muir Glacier has retreated seven miles in 20 years. Therefore, it comes as a surprise to geologists when I tell them that all glaciers in the Far North are advancing, and have been for at least the last 70 years, as clearly proved by the maps and accounts of our early explorers.

My own observation during the last 15 years confirms this. If they are advancing, why? Is it due to an increase in humidity resulting in an increase in snowfall, or a re-elevation of the northern lands? Mountains are being covered, valleys are being filled, coastlines and islands obliterated. Vegetation is being killed, animal life consequently being destroyed, and the icefields of our North

Atlantic are increasing in area and adding to the dangers of navigation.

Greenland has an area of 500,000 square miles. Today 500,000 are covered with ice. A covering of the remaining 100,000 will influence life considerably, in that millions and millions more tons of ice will drift southward yearly to cool our waters and lower the mean annual temperature.

Ellesmere Land, now slowly being ice capped, will aid in bringing about this result. The result will not be marked until the hundreds of glaciers now filling the valleys reach the sea, when each will send out its fleet of icebergs to add to the already congested northern waters.

How rapidly are these glaciers advancing? This is one of the purposes of my expedition—to mark clearly for future reference the faces of many of our largest glaciers. When other explorers return in future years, they can bring us back something definite. Had Kane, Hayes, Hall, Greeley, and Peary done this, they would have made invaluable contributions to science.

WITH this promise to Science, Captain MacMillan's article concludes. What are the potentialities of the information he submits?

For the first time in the history of polar exploration, as Captain MacMillan modestly states, his expedition will plant landmarks in the vast fields of arctic ice to permit scientists of the future to forecast exactly when the earth will know its next Age of Ice, when a great portion of northern North America may be buried like the poles beneath huge mountains of solid ice when vegetation may disappear from the Northern Hemisphere when man and animals may die and the earth be habitable only near the equator.

Science tells us that today we are at the end of a glacial period of 25,000 years, one of three to five such periods the world has known in a half million years. The interglacial periods—those when the midlands of our globe are as we see them now—last for 125,000 years or more, so immediate fear need not enter into our consideration of the possibility of a return to the Age of Ice.

While science can only theorize as to the cause, it can tell almost with certainty the history and effect of the previous glacial periods. Their stories are written in the face of the earth; in the contours of mountains, the beds of streams, the shore lines of inland waters, the depths of valleys. For when billions of tons of ice move irresistibly over the land, they hew, cut, and carve from their path anything that threatens to halt their progress, smoothing the mountain faces, leveling the hills, gouging out the valleys and altering the cliffs.

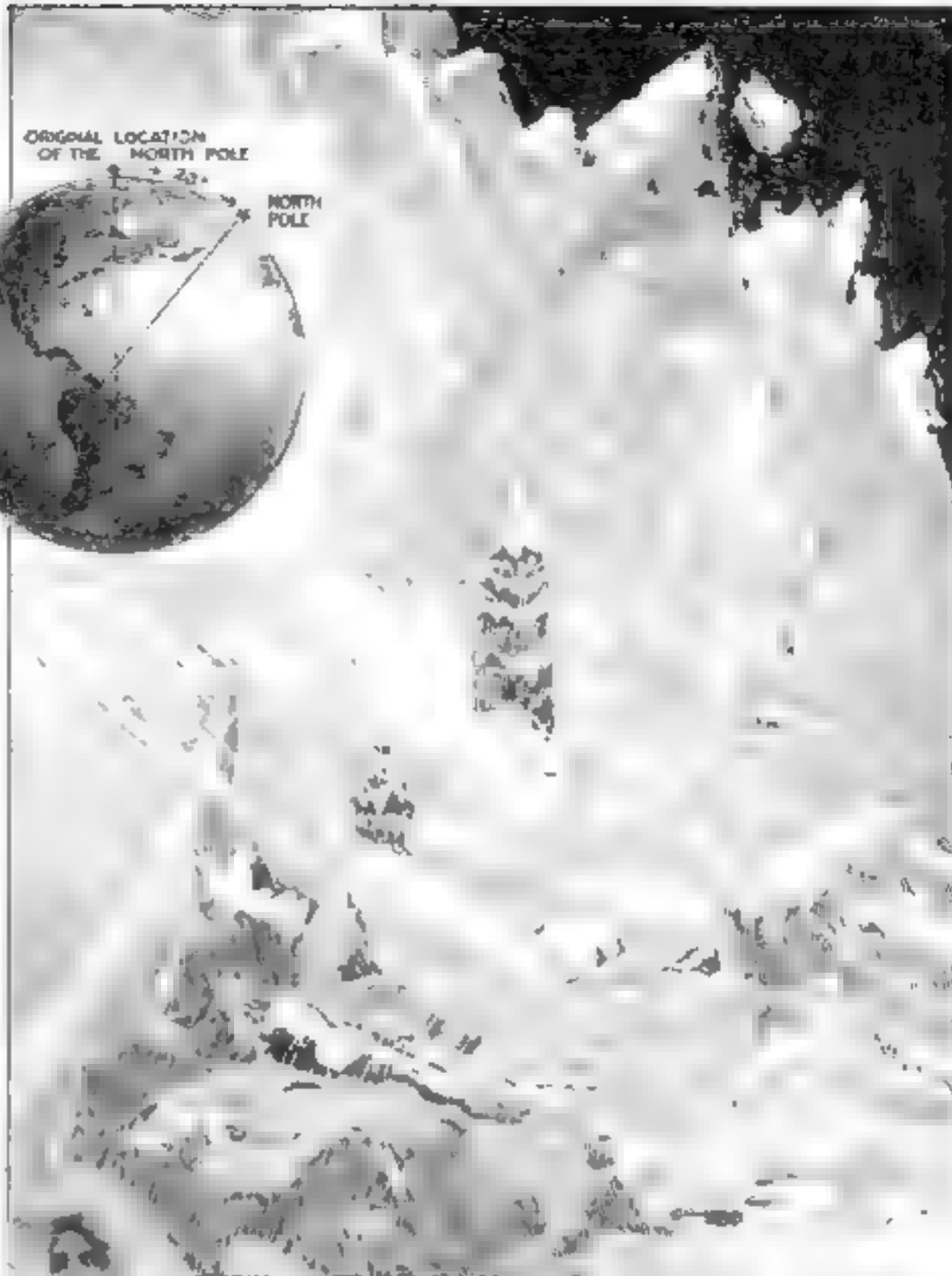
The next Age of Ice may obliterate a civilization that it has taken mankind centuries to achieve. Great cities may be swept away before the relentless march of the glaciers. The crumpled stones of their tallest structures may be returned into the earth whence science snatched them or carried on by the flood waters of the melting period into the seas.

Possibly this happened in the last age of ice. Possibly before



ORIGINAL LOCATION OF THE NORTH POLE

NORTH POLE



How our artist pictures the next great Ice Age. The glaciers, in their relentless advance, sweep away and crush the tallest skyscrapers of our cities, blotting out the modern civilization built by science. The inset illustrates one of the scientific explanations of glacial periods—the change in the earth's axis of rotation and consequent shifting of the poles.



Will our descendants wear clothing like this? Here is Captain MacMillan dressed in a parka of arctic furs.

that time America, Europe and northern Asia knew a civilization beyond that of which we are now so vain! The present sum total of human knowledge may have been surpassed prior to the last advance of the devastating ice. All the scientific discoveries that make our lives pleasant and safe may have been in the hands of the ancients whom the last glacial period removed from the earth.

These fascinating mysteries of

the past and the future lend special interest to Captain MacMillan's expedition—an interest that has been heightened from the standpoint of the future by the present widespread use of radio. Radio enthusiasts all over the country are ready to tune in on WNP—Wireless North Pole—the call number assigned the *Bowdoin*, which carries the first broadcasting station ever to move over arctic ice.

Radio Expert of the Expedition

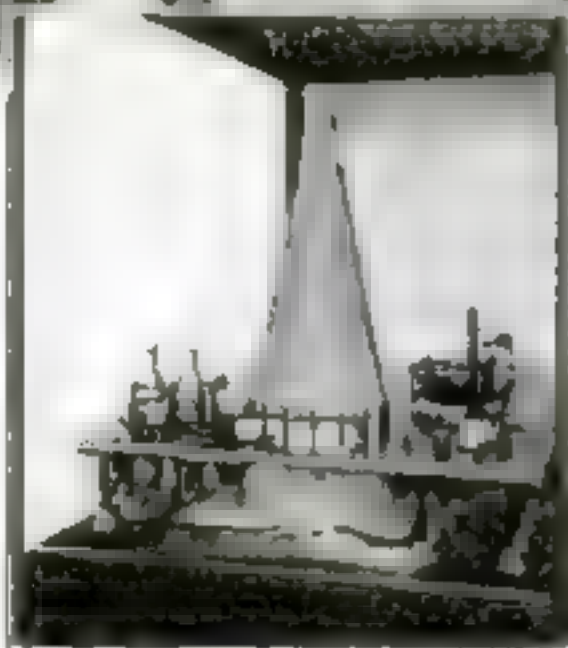
Hiram Maxim, dean of all radio amateurs in America, was responsible for the selection of Donald Mix, of Bristol, Conn., as the radio operator of the expedition. Mix's fellow members of the American Radio Relay League have agreed to do their best to maintain communication with WNP at all times. Messages from the *Bowdoin* will be broadcast by transmission from WJAZ station at Chicago. In addition to keeping the world informed as to the progress of the expedition, the *Bowdoin's* radio equipment will permit the crew to listen in on the popular radio programs, a diversion new to polar expeditions.



Tiny Models Illustrate Industrial Methods

LITTLE models of industrial plants illustrating the construction and operation of various mines, furnaces, etc., are on display at the Division of Mineral Technology in the United States National Museum at Washington, D. C. Two of these are illustrated here with the shaft coal mine above and the pot glass furnace at the right.

The model at left shows the shaft coal mine, tipple, miners' cages and the underground workings in which the miners are now cutting coal by electrically driven tools built accurately to scale.



New Railroad Ditcher Is Versatile Machine

HIGH efficiency, extreme mobility and versatility, and low maintenance cost are said to be features of the improved heavy duty, revolving type railroad ditcher shovel shown below. It is possible to mount this machine on railroad trucks of standard or special gage, traction or continuous tread trucks. This adaptability makes the same machine available for use in cleaning ballast, laying rails, ditching rights of way, loading and unloading, and stacking coal. It may also be used as a locomotive crane and has numerous other utilities.

The machine also is designed for ready

conversion to a steam shovel, crane, single line clamshell, or dragline outfit. All points exposed to intense stress are reinforced.

Relief for the Rheumatic

MORE than 4000 sufferers from rheumatism are said to have enjoyed an 80 per cent amelioration of symptoms under the bacteria injection treatment given 6000 patients during the last four years at the clinic of the New York University Medical College. In several instances the improvement effected is said to have been equal to a cure.

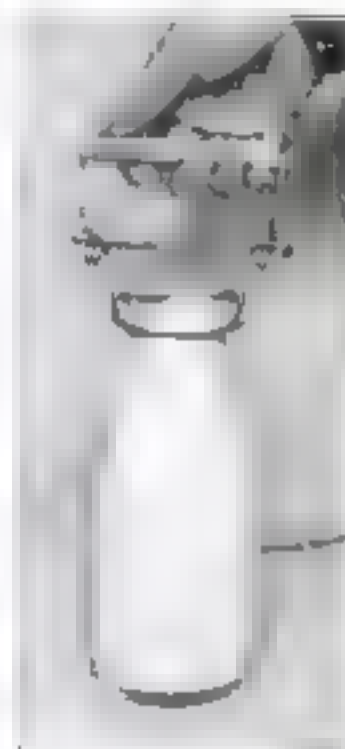


Wide use of this new railroad ditcher, because of its remarkable mobility and versatility will, it is claimed, render unnecessary many machines now in use.

Safe Milk-Bottle Carrier for Children

NO LONGER is there any reason why four-year-old Buddy should go forth to the store with a dime, some pennies, and a milk bottle and come back sobbing in a few minutes, penniless and milkless, except for what is splashed on him. Unless he falls down, the bottle carrier here shown will safeguard against childish carelessness.

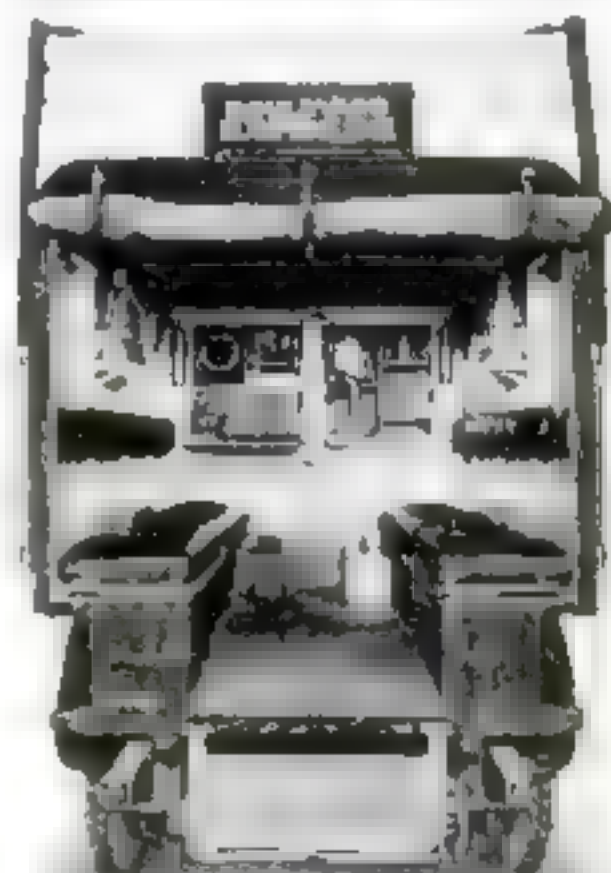
This carrier holds the milk bottle securely once the wire cross piece has been locked in place. The grip may be adjusted to fit a bottle neck of any size, and the wooden handle gives comfort to the one carrying it, without danger of slipping.



The handle in use

A Wireless Service Truck Answers "SOS" Calls

A WIRELESS sending and receiving set has been added to the equipment of the service truck operated by a Los Angeles transportation company. This truck is stationed halfway between Los Angeles and San Diego, Calif., keeping in touch with the home station, so that almost instantly it can be advised of a com-



Note wireless set installed in truck

pany truck in need of repairs along the road between the two cities. It also answers distress signals from private cars, the owners, of course, paying the standard rate for whatever help is rendered.

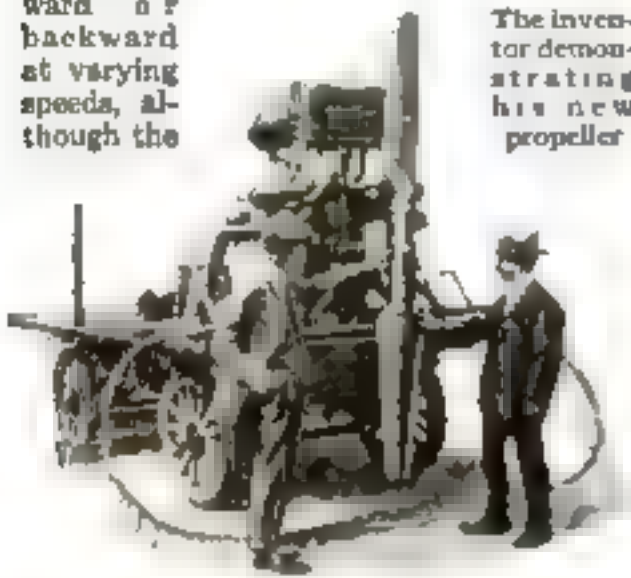
The owners of the service truck believe that before long such wireless equipped repair cars will be maintained on principal highways all over the country.

Airplane Speed Controlled by Adjustable Propeller

SHOWN below is Spencer Heath, of Baltimore, Md., demonstrating to Major-General Haraguchi, of the Japanese army, his recent invention, an airplane propeller with adjustable blades that may be altered in pitch simply by pushing a button. This feature is said to make possible a wide range of speed as well as to provide an effective brake to be used in landing.

Mounted on a trailer truck, the Heath propeller proved capable of driving the truck forward or backward at varying speeds, although the

The inventor demonstrating his new propeller



blades revolved at full speed throughout. One adjustment enabled the truck to remain stationary while the propeller was revolving swiftly.

Among the advantages which the inventor claims for his propeller are these:

It provides aircraft with a variety of speeds, instead of only one speed, as at present. It supplies a brake when revolved in a reverse direction, and in consequence obviates the necessity of a long run in landing. It permits tuning up the engine of an airplane without the necessity of checking the plane; for, when set at neutral, it produces no forward impulse.

Metal Chain Will Prevent Finger Sucking

SMALL children can be cured of the finger-sucking habit if an arrangement of bands and dangling metal links is clamped around the end of the thumb or finger, says the inventor of this device.

When the child attempts to put the finger, with band and chain attached, into its mouth, the metal parts come in contact with the tongue and the roof of the mouth. The result is unpleasant, but not painful.

After experiencing this disagreeable sensation a few times, the child will be cured of the habit, the inventor claims.



Dangling links hung from metal bands discourage thumb sucking by infants



New Parlor Golf Game Played with Manikins

MANIKINS that play real golf on the parlor floor, under the control and direction of players, feature a new indoor golf game that includes tees, greens, bunkers, and even the water hazards of the outdoor game.

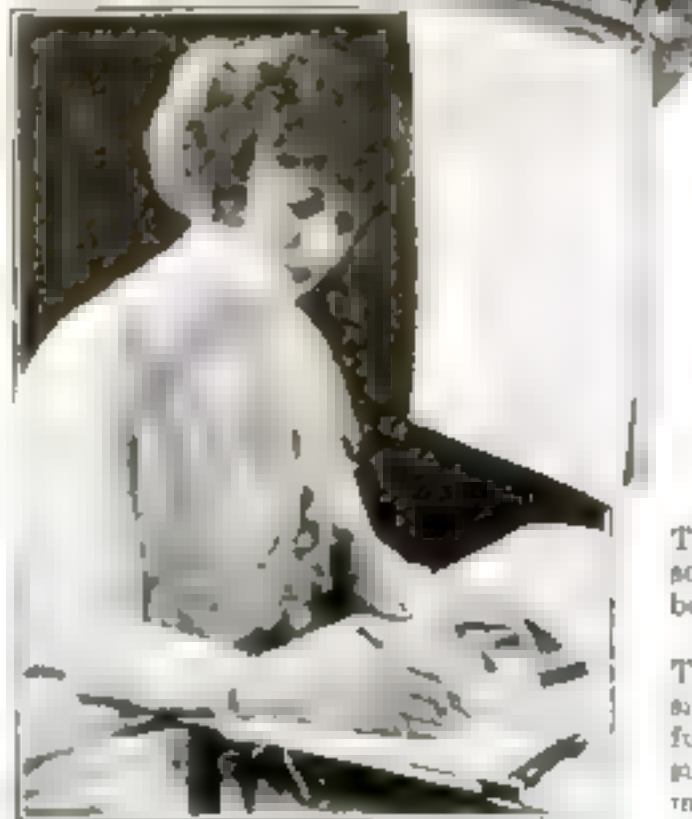
The game is played with a club resembling a driver, which has the figure of a miniature golfer in place of the usual

wooden head. The arms of the manikin are pivoted, so that when the player pulls back a lever in the club handle, the doll swings a tiny golf stick and strikes a small celluloid ball.

Considerable skill is required. If the little player is not directed properly, he will fizzle completely. Length and direction of the strike both are in the player's control.

Convenient Bridge-Score Pad Clamps to Table

How pad is attached



EVERY one who plays bridge knows what an annoying article the score pad is. Sometimes you can't find it when you're ready to play. When you have found it and have started the game, the pad is likely to evidence an exasperating habit of traveling around the table, getting mixed up with the cards, or falling to the floor. Or the pencil may be lost.

These annoyances are eliminated by a bridge-pad holder that recently has been put on the market by a Connecticut manufacturer. A spring clamp holds the pad securely to the table, so that it is always ready for use at the scorekeeper's side and can be written on without being held in place by the hand. The outfit includes a refillable pencil and a socket for the pencil that prevents it from being mislaid.

The number of living organisms in one single gram of soil, no more than a teaspoonful, exceeds 40,000,000, according to a census taken at a British government experiment station.

Midget Locomotive Made of Old Ford Parts

A MINIATURE locomotive constructed of Ford parts is attracting attention at Culver City, Calif., where it is being displayed by De Witt Brady.

The connecting rods are the only parts used in the motor car that serve the same purpose in the locomotive.



Ford parts were used throughout in building this locomotive

Monobus May Bring Cheaper Rides

THE monobus, a hybrid of trolley car and autobus, has been suggested as the possible solution of transportation problems in suburban districts. By its use the cost of installation and expense of maintenance could be reduced, it is claimed, to the limits demanded by infrequent trolley service in thinly settled communities.

The monobus would be supported by two trolley-car wheels and two bus wheels. The trolley-car wheels would be located nearer the center of the bus than the truck wheels, and would run on a monorail laid on the edge of the highway. The auto wheels would make use of the paved or dirt area. Rapid transportation would thus be confined to one side of the road. Very little pavement, if any, would need to be broken to prepare the railbed. Either an overhead trolley driving electric motors, or gas engines, could be used for motive power.

The main advantages claimed over an



Our artist's conception of the proposed monobus. The diagram illustrates how one rail and a sidewalk would provide traction

automobile bus are a diminished wear on roads, and reduction in tire cost, since there would be but two tired wheels, on which only 40 per cent of the load would fall.

Remarkable Sun-Dial as Accurate as a Watch



ONE of the most unusual sun-dials in existence is that at Columbia University, New York City, presented recently

by the class of 1885. A 15-ton granite sphere casts a shadow upon the base so that the east and west edges of the shadow exactly pass through two marked points at high noon on any day of the year.

Two bronze plates east and west of the great ball are marked with a series of lines and points. Thus, for the tenth of April, at noon, standard time, the shadow crosses the April line on the two plates at points marked 10.

If the shadows are observed simultaneously, the moment the shadow lies as above stated is high noon.

At least two months will be indicated by the shadow on each plate, but only one month by both.

The calculation of these dial plates required months of work, first, because standard time was not the same as astronomical time, as determined when the sun reaches the zenith; secondly, because the base was a cone and the shadow a cylinder, making it necessary to compute the shadow line on the conical base.



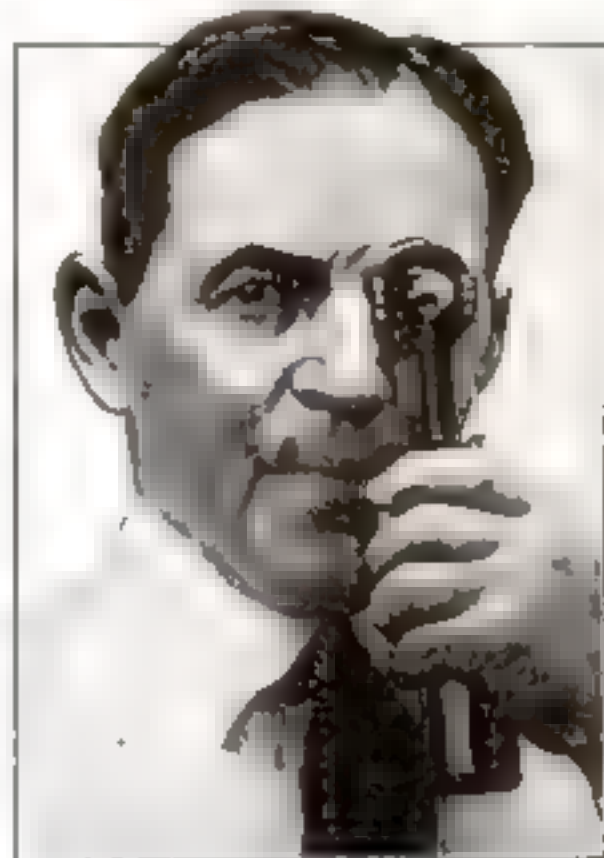
Indicating noon, April 8 or July 22, determined by the shadow on the west plate



Tiny 18th Century Watches Rival Modern Handiwork

MODERN jewelers who have produced a "dime size" watch movement, small enough to be mounted on a finger-ring, point to the achievement as an example of the progress made in the watchmaker's art, but our illustration shows that small movements are nothing new.

The little timepieces in the handles of these jeweled knives were made in the eighteenth century, almost two hundred years ago. The production of such a small movement entirely by hand tools affords as fine an example of watchmaking as anything the present-day jeweler can offer.



Dr. W. D. Bates and his lie detector

Lies Read in the Eyes by Novel Detector

LIES, even those harmless lies that lubricate so many of life's situations, promise to become hazardous luxuries if the "retinoscope," a lie-trap devised by Dr. W. D. Bates, noted New York City ophthalmologist, is vindicated by experience and comes into wider use.

According to the inventor, prevarication produces a mental strain, a generally conceded contention. This, he says, results in a temporary nearsightedness. It is this effect which is detected with disconcerting accuracy, it is said, by the retinoscope.

The instrument reflects a bright light into a mirror. The suspect's eye is studied through it while he reiterates the doubted statement. If he is drawing upon imagination rather than memory, the shadow of the retina, according to Doctor Bates, moves in a direction opposite from that of the shifting mirror.

Mastering the Science of Billiards

By Willie Hoppe

Champion Billiard Player of the World



© Kermans

Willie Hoppe, world's champion billiard player executing a typical draw shot. Notice how he holds his cue loosely between thumb and forefinger, using the remaining fingers as a guide.

HERE are Champion Hoppe's rules for improving your game of billiards:

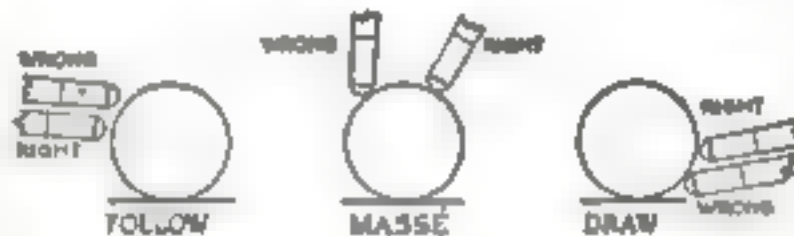
1. Use a cue that feels comfortable in your hands, hold it lightly, chalk it frequently, and, unless making a special shot, keep it horizontal.
2. Never attempt a shot without first learning the "why" of it.
3. Hit the balls no harder than is necessary.
4. Follow through from four to six inches on every shot—including the draw.
5. Hit the cue ball in the center.
6. Remember that many difficult-looking shots become easy if played off the cushion.

NO ONE would dream of plunging into deep water without first learning how to swim. Yet almost every day I see men attempting to play billiards—one of the most complicated and scientific games ever devised—with no knowledge of its fundamental principles beyond the fact that it consists of knocking three ivory balls around a felt-covered rectangular table with a tapering stick called a cue.

That may seem like an exaggeration, but I assure you it is not. Possibly 90 per cent of those who will tell you they "play billiards" have not the remotest conception of the definite scientific principles upon which the game is founded. Every billiard shot is a scientific problem, the solution of which requires practical knowledge of mathematical and mechanical truths and a fine adjustment of the player's mental and physical being. Although there are thousands who play at billiards all over the world every day, there are less than 10 who may be called first class players and certainly less than 100 who play the game well enough to turn in creditable scores day in and day out.

Of this little handful of expert players some of them, I feel sure, possess no better physical equipment for the game than those who must be classed as "dubs," but they have succeeded because they have learned to play the game with their brains—that is, scientifically. The average man who has enough interest in billiards to attempt to play the game occasionally, with a little thought and a little intelligent practice can bring about an almost magic improvement in the quality of his play.

The first and most important step to be taken in improving one's billiard game is a proper adjustment of the mental attitude—the psychology. Take the game seriously, and develop confidence in your ability to play it. The value of self confidence was brought home vividly to me early in my career as a professional player. On January 16, 1906, when I was 18 years old, I was



Right and wrong positions of cue in striking the ball for three of the most important and useful billiard shots

playing Maurice Vignaux in Paris for the professional championship of the world. Although I had been playing in public for 11 or 12 years, I was nervous. It was my first championship match. Vignaux was a four to one favorite. When we began to play, however, my nervousness left me, for I concentrated on the game and tried to imagine I was merely practicing on my own table at home. In France they divide a match into two periods. At the beginning of the second half it was anybody's game. In my first inning I found myself confronted by a ticklish shot. All the effect of the "self-kidding" I had been doing left me. Frankly, I was scared. If I should miss the shot, Vignaux would be left in excellent position to start a long run and win the match.

Should I try to make the shot, or should I miss purposely with the idea of leaving the French master out of position?

I hesitated before answering. Then I said to myself, "Willie, you're not going to get very far if you're going to be afraid to take chances. You've made harder shots than that a hundred times. Go to it!" So I chalked my cue, made the shot—and

then ran 93, the longest run of the match.

That shot was the most important of my life—not because it virtually won the match and my first world's championship, but because it taught me something that every billiard player should know—never to attempt a shot unless you intend to make it count. Since that time I've been tempted

to play safe many times, but I've never done it.

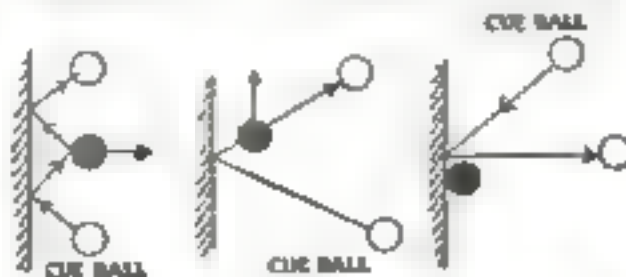
That, then, is the psychology of billiards. Now for the mathematics and mechanics.



This follow shot Hoppe calls "my most important." By making it successfully, he won his first world's championship match.

Most amateur players, I believe, would do better to use a soft tip in order to avoid miscues. A miscue in the last block of my match with "Young Jake" Schaefer in Chicago on March 29, 1922, probably prevented me from regaining from him the billiard championship of the world at that time. I was in excellent position with only 32 points to go when the miscue occurred. "Jake" immediately ran out the 10 points he needed and won the match.

Having found the cue that fits you, the



Three ways in which apparently difficult shots can be executed easily by hitting the cushion before striking either object ball

next thing is to learn to hold it properly. Don't grasp the butt with all your fingers as though it were an ax. This is a mistake made by most amateurs. The cue should be held lightly, almost loosely, between the thumb and forefinger, the remaining fingers serving only as a guide. No matter what sort of shot you are attempting, make your stroke smooth and steady—never jerky—and, unless you are trying to produce some special effect, keep the cue horizontal. Do not raise the butt! This causes the ball to spin and impairs accuracy. It is probably the cardinal sin of most unskilled players and one of the principal reasons why they remain unskilled.

Another important point—unless making a massé, or some other shot that does not permit it, always follow through from four to six inches after hitting the cue ball. Follow through even when making a draw shot. The "draw"—the backward motion that the cue ball takes after striking the object ball—is not produced, as many seem to think, by a quick, jerky, upward movement of the tip of the cue, but by the backward rotation which is given to the ball by striking it below its center. The steadier the stroke and the longer the follow through, the greater will be this rotation. Many players fail in attempting draw shots because they flinch, apparently fearing to give the ball a full forward stroke because they know they are trying to produce a backward motion.

Unless you have some good reason for doing otherwise, always strike the cue ball in the exact center, or just above it. This causes it to travel forward in a straight line and gradually to acquire rotation about a horizontal axis from the friction of the cloth. Striking the ball that way causes it to go exactly where you want it, and in a straight line.

Don't Hit Too Hard

Another warning—if you hit the cue ball harder than necessary, the result will be almost invariably a "bad leave," that is, the balls will be driven so far apart that your next shot will be a difficult one.

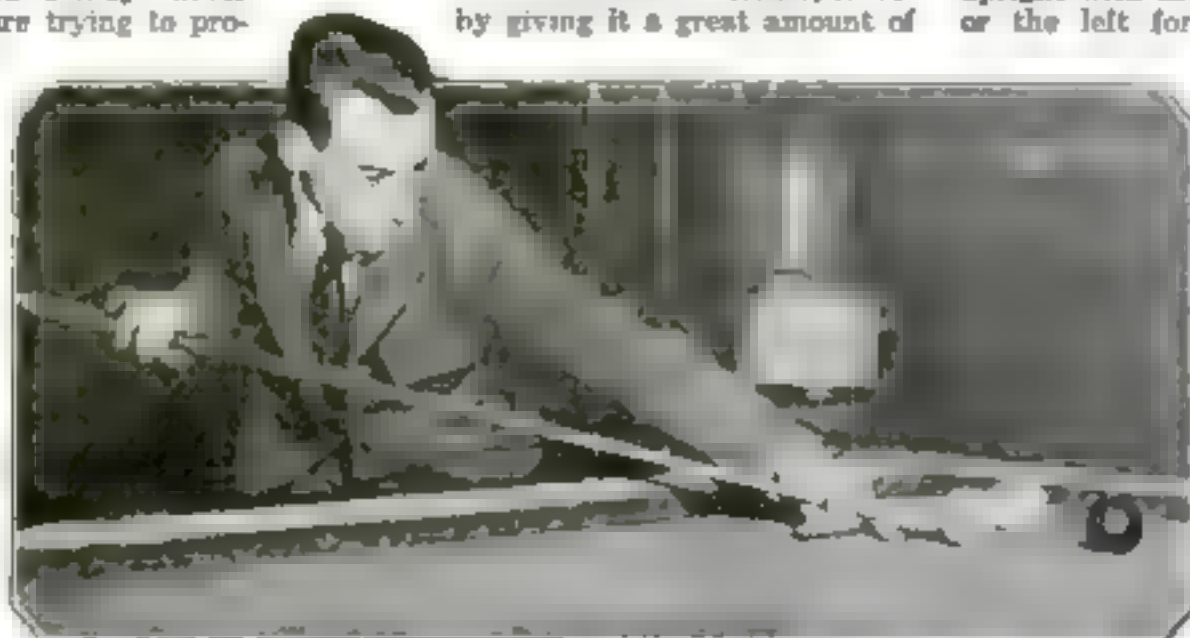
Don't be afraid to chalk your cue, and always chalk it when attempting a draw, follow, English or massé.

For practice in stroking I know of nothing better than driving a ball from one end of the table against the opposite cushion and holding the cue after the follow through to permit the ball to rebound against it. This, unless you are a player of some skill, you will find more difficult than it sounds, for, unless the ball is struck in the center, or exactly above it, a greater or less amount of English will be imparted and it will fail to return to the place from which stroked.

There are, of course, an infinite number of shots possible on a billiard table. To attempt to describe specific shots would be futile, but there are general principles involved in all shots which I shall try to describe briefly.

All billiard shots may be considered as belonging to the following classes or to a combination of them—the carom, the draw,

the follow, the bank, and the massé. Carom is the word used to describe the rebounding of the cue ball from the object ball after striking it. It is probably the shot most frequently used by the inept player. The draw I have already mentioned. The follow shot is quite well described by its name. It is made by striking the cue ball above center, thereby giving it a great amount of



"Young Jake" Schaefer, ex-champion, from whom Willie Hoppe recently regained the world title. Notice the nearly horizontal position in which he holds his cue. Raising the butt of the cue impairs accuracy, Hoppe declares.

forward rotation, which causes it to continue on its path after striking an object ball.

Bank, or cushion shots, are probably self explanatory and we shall make no distinction here between those in which the cue ball strikes a cushion before striking

either object ball and those in which the cue ball strikes one object ball first, then the cushion, and then the second ball. The massé may be called exaggerated English. It is made with a nearly vertical cue against one side of the ball with aim taken almost through the center of the ball. In making it, the left hand may be held upright with the tips resting on the table, or the left forearm may be held rigid against the body and the cue directed against the ball through a loop-finger bridge.

In a massé, the cue ball describes a curved path, permitting the execution of direct caroms that otherwise would be impossible—when the three balls are in line, for example. In a short massé, little force is necessary, although the tip of the cue must "catch" the surface of the ball to give it the rotary motion that makes it curve.

Since the opportunity to score points by direct caroms is distinctly limited in a billiard game, the cushions must be used constantly to cause the cue ball to reach its objective. The angles at which the balls rebound from the cushions furnish the geometry of the game. In this connection, the first thing to be remembered is that when a ball is driven against a cushion without English, the angle of rebound is always equal to the angle of impact.

When it is necessary for the player to cause the cue ball to rebound from the cushion at a greater or less angle than that at which it is directed against it, he employs English. If the English is put on the side at which the ball would naturally rebound if it were not used, the angle of rebound will be lessened, that is, the ball will rebound more nearly parallel with the cushion. If the English is put on the other side, the angle of rebound will be larger; that is, the ball will rebound more nearly perpendicular to the cushion. When using English—unless attempting some other effect as well—hit the cue ball at half its height.

Practice Is the Best Teacher

I can't give any rules for determining the amount of English to be put on a ball. Nothing but practice will teach you that, and you can obtain the best practice, not by playing matches, but by setting the balls on the table and practicing the same shot over and over again until you are able to execute it perfectly.

The average unskilled billiardist makes the game more difficult than it actually is by failing to learn the fundamentals before attempting to play. This means work. I am 35 years old and I have practiced billiards not less than an hour a day since I was a boy of six. Also, when preparing for a match, I train—on the roads—almost as severely as a pugilist, for billiards is a trying game and good condition of the body and nerves is essential to success.

I do not expect any one who plays for amusement to tie himself down to any such rigid routine as mine, but I would advise him to take as much care with each shot as though a world's championship depended on it.



© Kyrle
Roger Conti, one of the world's leading billiard experts, demonstrating the massé shot. Note how near the center his cue, held vertically, hits the ball.

Armored Monster Once Roamed Texas

24/81



Smallest Full-Grown Horse in the World

THIS is Tiny Mite, the smallest full-grown horse in the world, 26 inches tall and weighing 51 pounds. His diminutive proportions are the more remarkable because he does not come of any diminutive breed of equines. He has as his sire and dam respectively, Baron B. and Lady Raffles, full-sized thoroughbreds and former race horses. Tiny's home is at Revere Beach, Mass., where his owner has erected a special miniature barn for him.

Solid or Pneumatic Tires Worn by New Wheel



A NEW wheel design for motor trucks permits the use of solid or pneumatic tires without changing the wheel. On the wheel in the center may be placed either the solid tire and wide rim shown at the left or the pneumatic tire and rim shown at the right.

Tennis Balls Are Cleaned by Brushing Machine

DIRTY tennis balls, which grime the hands and white sport clothes, now can be banished inexpensively, it is claimed.

But it is the condition and not the ball that readily is banished.

Stains of grass or clay are said to be effectually removed by the recently patented brushing machine here shown. This device is screwed to the wall, or to some solid object convenient to the tennis court. The dirty



balls are placed between the brushes through the swinging gate, which is shown open in the illustration.

Two balls can be cleaned at once, their separation being accomplished by a curved arm. When the handle is turned, the brushes revolve, reaching every portion of the balls' surfaces and causing them to leave the machine looking very much like new.

Palaeoscincus, or "armored dinosaur," as it probably appeared when it roamed the Texas plains 65,000,000 years ago: a restoration from fossilized skeleton below found in Texas



MANY thousand years ago this formidable looking creature roamed the plains of Texas. Perhaps it was the original Texas steer. This striking animal is Palaeoscincus, the "armored dinosaur," a restoration of whose skeleton has just been placed

in the American Museum of Natural History, New York City.

The scientists who exhumed the fossilized remains and made the restoration, say that, despite its forbidding appearance, the beast was really a gentle and peaceful creature that lived on grass. Its spiny armor, it seems, was utilized only as protection.

The creature stood about five feet tall, measured approximately 20 feet from nose to tail, and was about as easy to damage as an armored tank.



World's Champion Hen Has Laid 1300 Eggs

ABOVE is Mrs. Lyle Funk, of Shirley, Ill., holding her prize white Leghorn hen, Lady Anne, said to be the champion egg producer of the world. Lady Anne is 10 years old, and in the nine years that elapsed since she learned to lay has produced more than 1300 eggs, with a total weight of about 175 pounds.

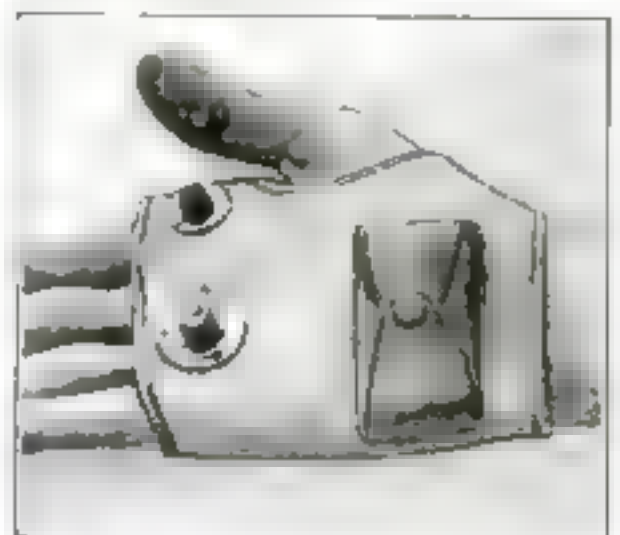
The poultry books say that the world's record for egg production is 1355, held by a hen which has long since passed on. Lady Anne's owner expects her to exceed this record by a wide margin, since she is still a steady producer, and so healthy that any actuary would give her several more years to live.

Burglar Carries Lamp in Palm of His Glove

A SAFE-CRACKER'S ingenious lamp attached to the palm of a glove recently was seized by Detective Captain Sam Street, of San Antonio, Tex.

In the palm of the glove is a pocket, in which is placed a small electric battery. Flat wires lead the current through the switch at the base of the index finger to a bulb at the base of the third finger.

This arrangement enables the burglar to press the switch button with his index finger while shielding the light so that it will not be visible from behind. A sufficient amount of light is projected forward to enable him to read the combination on the safe he is about to rob.

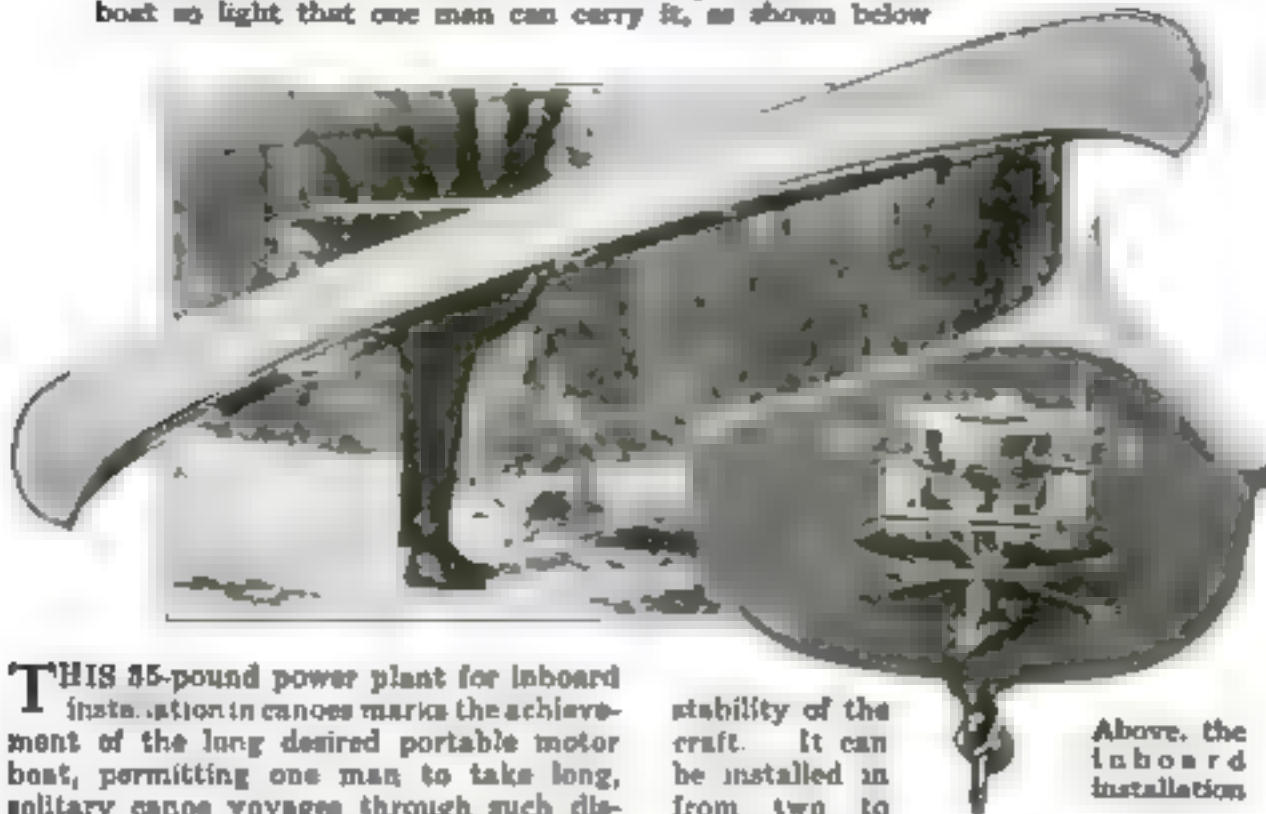


Lamp and switch button in glove

WITH British and French engineers completing plans for a 31-mile traffic tube under the English Channel, a transportation dream 128 years old now seems likely to be fulfilled. This gigantic project to connect Dover and Calais by the world's greatest tunnel will be described with fascinating and authoritative illustrations in an early issue of Popular Science Monthly.

Midget Inboard Motor for Canoes

The diminutive new canoe motor makes possible a motor boat so light that one man can carry it, as shown below



THIS 35-pound power plant for inboard installation in canoes marks the achievement of the long desired portable motor boat, permitting one man to take long, solitary canoe voyages through such districts as the Canadian lake country, which require frequent portaging.

The motor is constructed so that it lies low in the canoe, thus greatly increasing the

stability of the craft. It can be installed in from two to three hours and removed in 10 minutes. A heavy, diagonal skeg from the tip of the projecting motor parts protects the propeller blades.

Above, the inboard installation

A Pocket Check Protector

PERFORATIONS to prevent the altering of checks, long used by business houses, are made available for personal checks by this new, pocket-size perforator.

The perforator is of silver plates, between which the check is placed and



punched. These perforations, opposite printed numerals on the margin of the check, designate the maximum amount.

Crane and Truck Combined in Mobile Lifting Unit

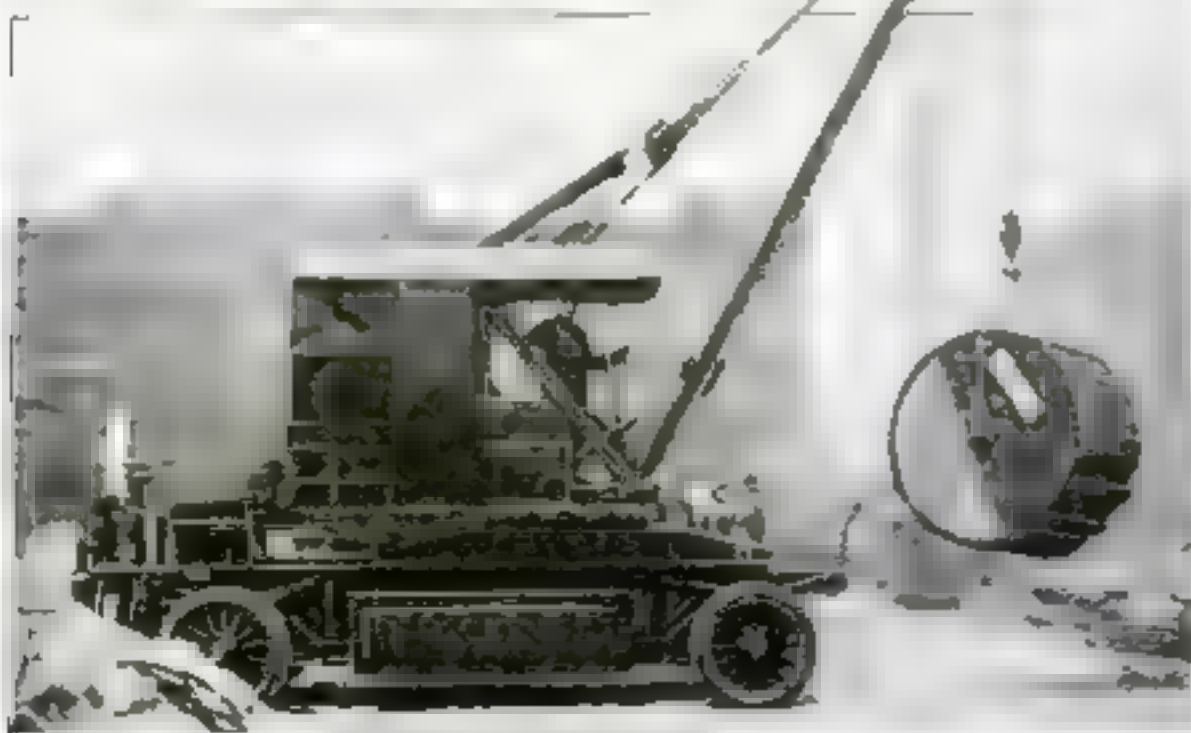
THE mounting of a lifting crane on a storage battery electric truck was accomplished successfully for the first time

recently by the New York Edison Company.

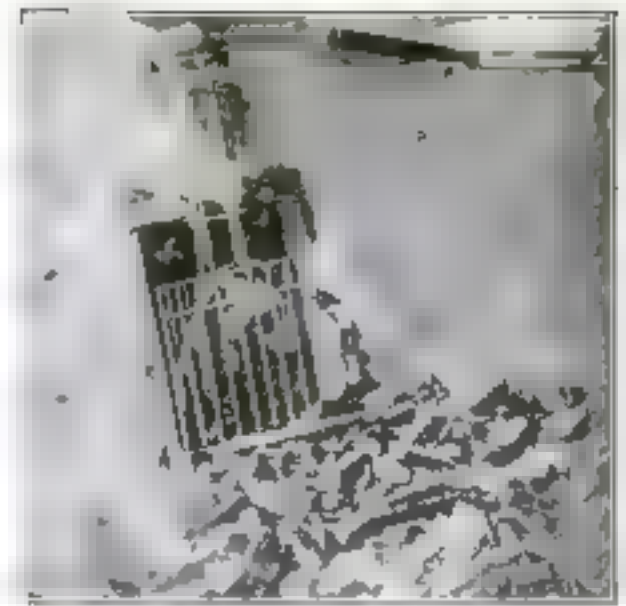
Since being placed on the truck, one of five tons, the crane has shown a lifting capacity at least 40 per cent greater than that at which it was rated by the manufacturer. This remarkably efficient performance results from the lowering of the crane's center of gravity by the weight of the storage battery.

The crane has been used successfully in such work as handling heavy reels of cable, loading coke and coal and piling manholes and castings. The device can pick up a large reel of cable and place it on a truck in from 30 seconds to 1½ minutes. The only methods practicable before its development required from 10 to 20 minutes for the same work, moving loads in smaller quantities and far more slowly.

The ordinary type of crane cannot be moved from place to place over city streets. The mobility of this new crane makes that easily possible. Hence it becomes making lifts for such work as is usually left to riggers.



The powerful electric truck and crane hoisting a large reel of cable



Upright Camp Fire Broiler for Outdoor Cooks

A NOVEL outdoor broiler that stands erect beside the fire has been invented for campers and picnickers. It is supported at the back by a sharp-pointed wire leg that is pushed into the sand or dirt.

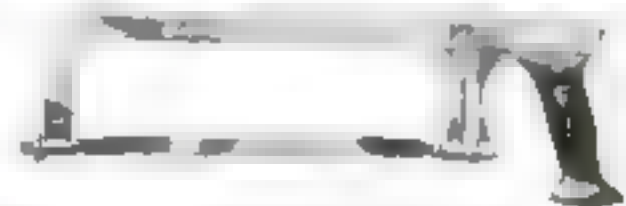
The invention really is a wire inclosed in a cooking pan. The flavor of food broiled over a camp fire frequently is spoiled by smoke—a disagreeable feature of camping that is prevented by the new device. Meat can be turned in it without being disturbed, and a fish being grilled will not be broken into unappetizing scraps.

The pan is fitted with a trough at the bottom, in which all juices and grease are caught. This pan also serves to concentrate the heat and keep hot the side already cooked.

A Novel Hacksaw Frame

EVERY mechanic who knows how vital a tool a hacksaw can be will find this recently patented frame interesting.

It is designed to undergo severe usage without springing. In designing the handle,



the inventor remembered the mechanic's comfort and shaped it to his hand. The frame is equipped with devices that allow the blades to be released and tightened quickly, and different sized blades to be adjusted easily. Quick setting of the blades to cut four different ways is also easy.

Filling Station for Pens

FOUNTAIN-PEN filling stations in office buildings, schools, and libraries are interesting possibilities of tomorrow.

The "station" pictured here has been operated successfully for months at the University of Chicago.

A penny dropped in the slot releases enough ink to fill an ordinary fountain pen. You may first drain your pen in the left-hand container and a penwiper may be pulled from the upper right corner.



He Saved a Million Lives

The Inspiring Story of Pasteur, Great French Conqueror of Disease,
Whose Centenary the World Celebrates

By R. E. Martin

THIS year the whole world is celebrating the centenary of Louis Pasteur, the great scientist, who, in point of alleviating suffering, has been called "the supreme benefactor of the human race."

France, the country of his birth, set aside six months in which to honor his memory by a series of fêtes and exhibits, one of which delegates from every country attended. In the United States the centenary is being observed generally by scientific societies and by the scientific departments of colleges and schools.

To the layman the name of Pasteur probably brings to mind only two great scientific achievements—the Pasteur treatment for hydrophobia and the heating process, known as pasteurization, by which milk is made germ-free and suitable for human consumption. These, tremendously important though they are, may be considered as only two incidents or phases of Pasteur's far-reaching life work.

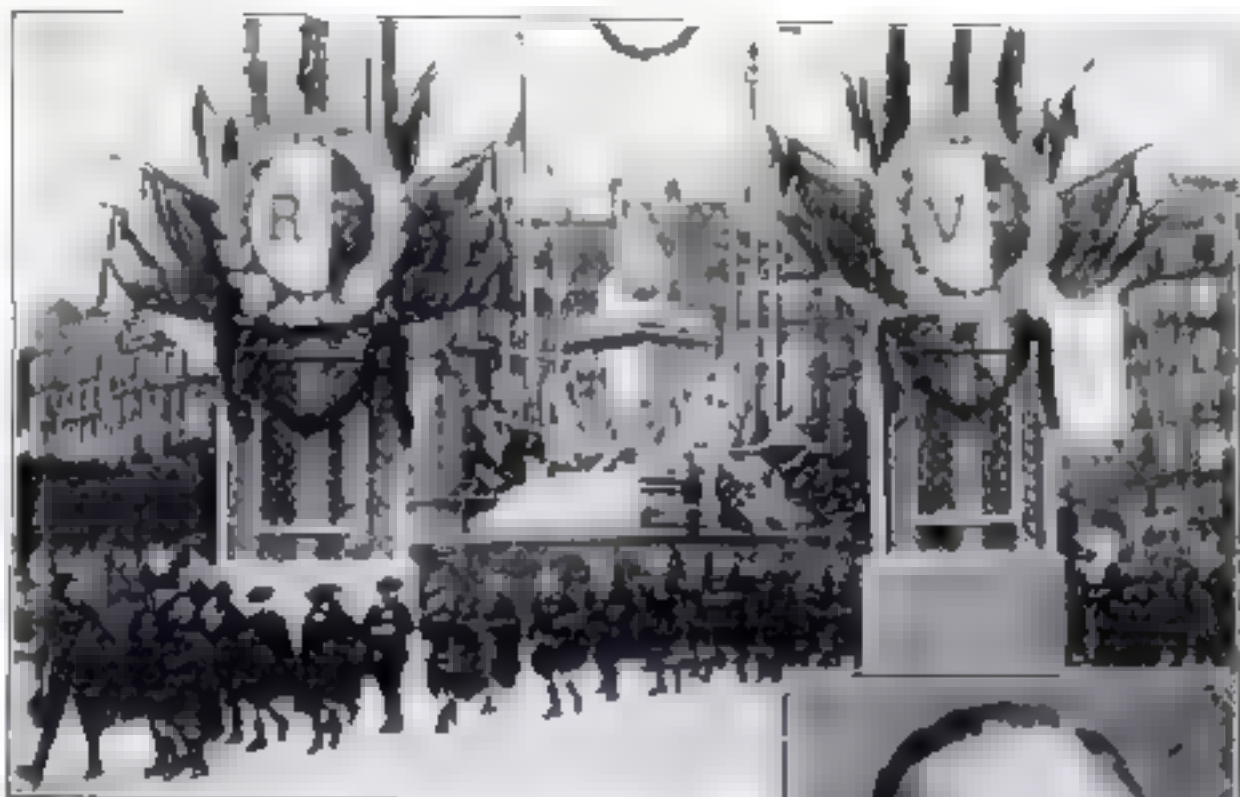
He it was who blazed the trail for modern antiseptic surgery. He it was who first developed the principles by which the medical profession now controls infectious and communicable diseases. By his researches he proved that the virulent plagues from which mankind had suffered for centuries were caused by living microorganisms—germs. And he was the first scientist to learn that these germs could be cultivated by man and injected into the bodies of sufferers to fight the very germs that caused disease.

He pointed the way to the present-day control of such frightful scourges as hydrophobia, tuberculosis, malaria, tetanus, infantile paralysis, leprosy, syphilis, dysentery, diphtheria, smallpox. And thus he saved at least a million lives.

He saved the herds of France from extermination by anthrax, and taught the world his methods so that they might be applied to cattle everywhere.

He saved the silk industry of France by finding the cause and the cure of a disease that was killing the silkworms.

He discovered that living microbes caused the fermentation of wine, beer, milk, and butter, and he taught the wine-makers of France how to grow their grapes so that poisonous fermentations could not develop.



Orphan children marching before the statue of Louis Pasteur in Paris, celebrating the centenary of the great French scientist who has been called "the supreme benefactor of the human race."

Although he was neither physician nor biologist, it is to him that both these sciences owe probably their largest debts.

The amazing feature of Pasteur's life is that his most important work was done after the age of 45, after he had suffered a stroke of paralysis that made him virtually a cripple for the rest of his life.

By training and profession Pasteur was a chemist. He was born at Dôle, the son of a tanner.

As a boy, and even as a college student, this great man showed no extraordinary qualities. In fact, his college diploma



Louis Pasteur

when the air was excluded. He followed up these discoveries by demonstrating in a series of intricate experiments that the germs were not generated spontaneously in the fermenting beverages, but existed in the air.

Not only did his findings teach the vintagers and brewers how to save their products, but when applied to surgery as antiseptics, they have taught the medical profession how to save human life.

Before Pasteur the percentage of deaths from infection after surgical operations had been as high as ninety. Now the most dangerous and complex operations are boldly performed without fear of infection.

It was Pasteur who first taught the doctors to sterilize their instruments by passing them through a living flame. Through his discoveries of the nature and sources of germs was developed the complete sterilization of surgical instruments and dressings as practiced in the modern hospital.

In 1865 the French silk industry had reached the verge of ruin through a fatal sickness that had attacked the worms. Up to that time Pasteur never had seen a silkworm, but, at the solicitation of a friend who lived in the south of France, where



Courtesy New York City Health Department

Grinding serum for the Pasteur treatment of hydrophobia, or rabies, in the laboratory of the New York City Health Department. The serum, extracted from the spinal fluid of animals, is converted into liquid form for human injection.

the scourge was rampant, he consented to visit the afflicted area and study the disease on the spot. It required six years of patient, discouraging work to trace the mysterious disease to its cause, and to find a cure, but Pasteur at last succeeded, and the silk industry was saved. It was while working on the disease of silkworms that Pasteur suffered the paralysis that left its mark on him through life.

Pasteur's work in every case was done in some kind of practical usefulness, to supply some economic or human need, yet Pasteur continuously looked up from this work of the moment into the future. Thus in 1879, long before he had attempted to turn germs of disease into a vaccine which would destroy disease, he wrote:

"Must we not believe that the day will come when preventive measures of easy application will arrest human plague which at one blow desolate and terrify whole populations, as did yellow fever in its recent invasion of the Senegal and the valley of the Mississippi, or the bubonic plague that has raged on the Volga?"

Saving Cattle

This question he asked in commenting on his work in checking the ravages of anthrax, which two years before had attacked the sheep, cattle, and pigs of France. It was in fighting this plague that Pasteur first was successful in utilizing a germ culture as a vaccine. This achievement science places in the forefront of his discoveries, for the only diseases which today baffle medicine are those of which the germ has not yet been found. Walking one day through a recently harvested field, Pasteur was struck by a peculiar red formation in the soil at certain spots. Investigating, he found that the color was due to cylinders of earth left

by worms. Upon making inquiries in the vicinity he learned that the carcasses of animals which had died of anthrax had been buried there.

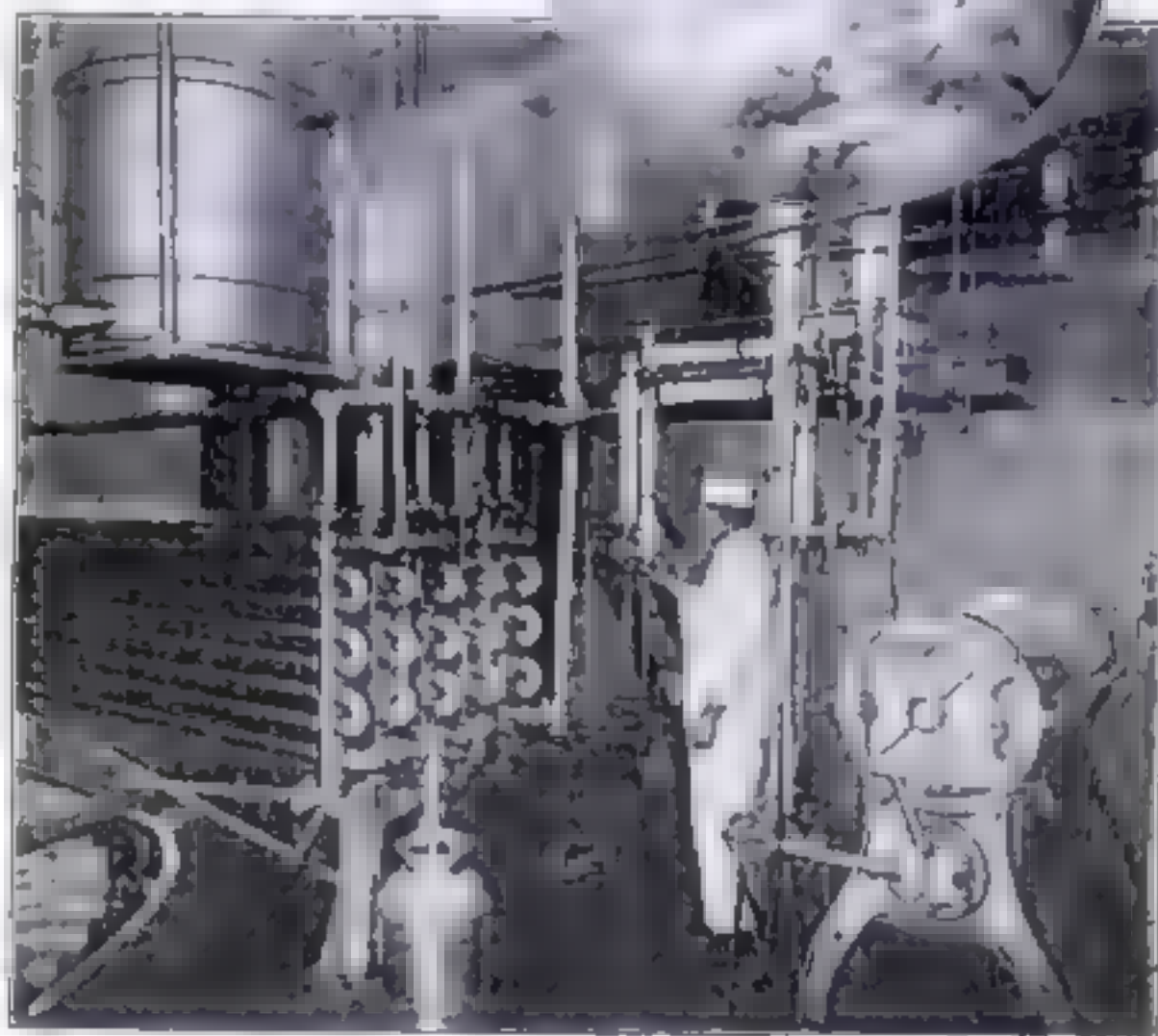
Instantly there occurred to his mind the possibility that the worms were spreading the anthrax plague. Examination of the worms disclosed the presence in them of a germ similar to a germ development found to exist in the blood of animals killed by anthrax. From the blood specimens Pasteur produced germ cultures with which he inoculated healthy animals. The animals so injected developed anthrax and the bacilli of anthrax were found in their blood.

Further experiments disclosed that the germ cultures, if subjected to heat, became weakened in their disease-producing qualities. This fact Pasteur interpreted to mean that in the germs of arrested growth the former virus had become a vaccine. Experiment substantiated his theory, and he announced his discovery, only to be

greeted with derision by scientists, veterinarians, and cattle raisers.

Pasteur, certain of his ground, agreed to subject his theory to a public test, which was arranged at Melun. A herd of 25 healthy sheep was injected with the vaccine. Then these and 25 other sheep which had not been vaccinated were inoculated with anthrax. Pasteur predicted confidently that within five days the animals that had been vaccinated would still be healthy, while those that had not

At the right, a highly magnified view of milk that has been soured by millions of bacteria. In milk held at a temperature of 68° F., bacteria multiply more than 4000 times every day.



Pasteurizing milk in a large dairy plant. Disease bacteria are destroyed by Pasteur's scientific process of heating and cooling the milk. Pasteurizers and

milk holding tanks are shown in the gallery. In the coils at the left the milk is cooled after it is taken from the tanks where the bacteria are destroyed.

received the vaccine would be dead. What he predicted came to pass. Scientists who had scoffed now applauded. Science accepted his discovery. His vaccine was put into use and the herds of France were saved.

Pasteur Develops Rabies Vaccine

Before the days of Pasteur, hydrophobia, or rabies, always was fatal. Of every 100 persons bitten by rabid animals, 16 developed the disease and all of them died. Studying the disease in dogs, Pasteur reached the conclusion that it had its seat in the nerve centers—an opinion substantiated by the fact that an injection of an extract from the spinal fluid of an affected dog resulted in the development of rabies by a healthy dog.

What Pasteur had done with the virus of anthrax he attempted to do with the virus of rabies. He developed a weakened culture which would constitute a vaccine.

Working constantly with dogs suffering from a disease that made their bite fatal was perilous work, but Pasteur never shrank from it. He developed his vaccine, and injected it into animals that had been bitten by rabid dogs. Invariably the animals recovered. Although these results pointed to success, Pasteur feared to use his vaccine on human beings.

On July 6, 1885, however, there appeared at his laboratory Joseph Meister, an Alsatian boy of nine, who had been bitten terribly by a mad dog. The boy's frightened mother begged Pasteur to attempt to save her son's life, and at last he consented.

Sleepless nights, the anguish of fear and constant watchfulness at the bedside were Pasteur's portion until the boy's recovery testified that once again he had prevailed over death itself. Three years later the Pasteur Institute was opened in Paris, and today there is not a country in the civilized world that does not support at least one similar institution. Thousands of people have been treated at these institutes. Through the treatment discovered by Pasteur, the death rate from this most terrible disease is reduced to less than one per cent.

Priceless Work

Of the money value of Pasteur's discoveries much has been said. His methods of curing anthrax, chicken cholera, and the disease of the silkworm saved France, so his contemporaries asserted, more than the whole cost of the war indemnity paid by France

to Germany in 1870. His work in the saving of human life is priceless. In the last half century the average span of life has increased 15 years, the infant mortality rate has been reduced one third, and the deaths from typhoid have been reduced four fifths. In no small measure are these improvements in public health the direct result of Pasteur's labors. Certainly his discovery of a cure for puerperal fever has saved the lives of thousands of mothers. Certainly the light he has cast on the field of preventive medicine and his development of vaccines led directly to the control of such diseases as typhoid.

Pasteur lived to enjoy in full measure the fame and honors that his work had earned. Long before his death—Sept. 28, 1895—the whole scientific world had been at his feet. Many monuments have been reared to him, but none will prove more lasting than humanity's grateful memory of the victorious fight he waged for all creatures against the hosts of death.

Young Inventor Aids Uncle Sam

How 18-Year-Old Postal Employee Ingeniously Doubled His Output

By H. H. Billany

Assistant U. S. Postmaster-General

NO BRANCH of the government service is more ready—I might say more anxious—to reward employees who evidence originality and ingenuity in the performance of their duties than the Post Office Department. Particularly is this so with regard to employees who suggest or develop improvements in mail-carrying equipment or in the machinery of the shops where the mail equipment is manufactured.

An interesting instance of this policy of the Post Office Department is furnished by a recent case in the mail equipment shops in Washington, D. C.

Antonio J. Lombardi, an 18-year-old employee of the mailbag repair department, for some time had been turning in time sheets that indicated he was performing about twice as much work as any other man in the shops ever had been able to do. Lombardi's particular job was the reaming of keyholes for mailbags.

Greenhorn Mystifies Experienced Men

His superiors in the shops could not understand how he, with only a few months' experience, could turn out more work than men who had been in the service for years. They began a quiet investigation. Experienced workmen, when questioned, asserted that it was impossible for one man to produce as much work as Lombardi claimed he was doing. They even suggested that there could be but one explanation—that his time slips had been padded.

Reluctant as they were to believe this, and failing to see what permanent benefit young Lombardi might derive from falsifying his records, the shop officials called the lad before them and bade him explain. Lombardi was embarrassed, but insisted stoutly that his time slips were entirely accurate. Pressed for further explanation, he at last led his questioners to his locker and drew from it a small block of wood on one side of which was carved a small half cylinder. This contrivance, he declared, was the secret of the unbelievable

amount of work he had been turning out. When the shop officials expressed their incredulity, Lombardi escorted them to his machine



Antonio J. Lombardi, 18-year-old post-office employee, who doubled his output in reaming keyholes for mail-bag locks by inventing the simple block shown in inset, and so won official recognition.

and inserted the block beneath the drill. The half-cylinder in the block fitted the curved end of the mailbag locks, permitting him to insert the lock with his left hand and work the reaming machine with his right simultaneously, instead of using both hands to perform each operation as other operators on the machines were compelled to do.

Lombardi explained that he had been accustomed to use the block at his work when he was unobserved. He hid it away in his locker at night, he said, fearing the

shop managers might reprimand him for making unauthorized improvements on government machines. When he had explained, he seemed to fear that he would be discharged for what he had done.

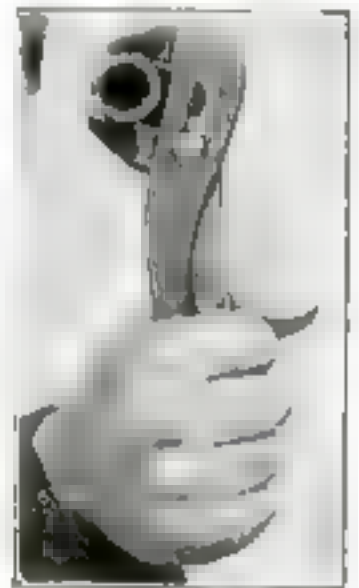
Instead, a report regarding Lombardi's device was forwarded to Postmaster-General New, who investigated its merits and ordered that a cash award be made to the lad for his invention and that he be given a certificate setting forth the reason for his reward.

And now Lombardi's device has been adopted by order of the Postmaster-General as standard equipment.

Combination Wrench Has Wide Range of Uses

A TOOL with an unusually wide range of usefulness is the combination pliers, monkey-wrench and pipe wrench illustrated here. It is quickly adjusted to fit various sized pipes, bolts, nuts, caps, nipples, and similar parts. It has a capacity for parts up to one inch square and 1½ inches round.

The tool is seven inches long, weighs about 12 ounces, and is made from a drop forging, machined, heat-treated and given a charcoal and gun finish.



Used as pipe wrench.

With Webbed Gloves, Bathers Swim like Ducks

BATHERS who claim to be able to swim like ducks now can make good their boast by equipping themselves, not with webbed feet, but with webbed hands.

The webbed rubber gloves shown below do the trick. Swimmers who have tried them say that they make the process of moving through the water almost as easy as walking. Since the webbing displaces more water than the bare hands, greater speed is obtained. The gloves also protect hands from being shriveled by water.



These gloves displace more water than bare hands and increase swimmer's speed.

What a Small Invention Did for Me

Prize Contest Announcement

READ Mr. Billany's inspiring story above. An ingenious idea won recognition from the postal authorities for young Lombardi. Perhaps you have had some similar experience. Possibly some simple device you have invented has helped you in your work, has won promotion for you. Tell us about it. Your letter should be based on personal experience. Remember that a simple story is likely to be the best.

For the best letter of not more than 400 words we offer these prizes: \$20, first prize; \$10, second prize; \$5, third prize.

Address letters to Invention Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City. Each letter will be considered by a board of editors, whose decision will be final. The competition closes October 23, 1923. Winning letters will be published in the February, 1924, issue. Contributions to the contest will not be returned unless accompanied by a stamped, self-addressed envelope.

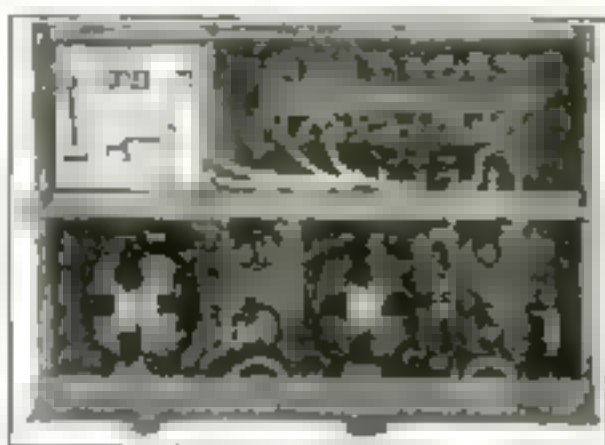
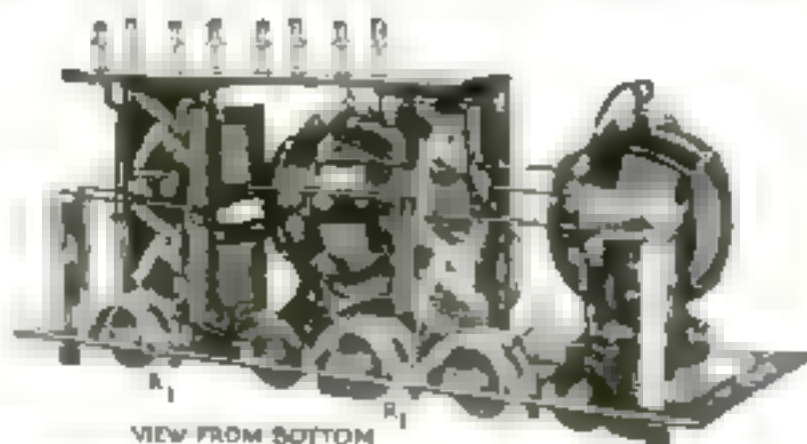
You Can Use Any Tube in This Set

TWO novel circuit arrangements are the features of the latest type of radio set, designed exclusively for the reception of broadcasted programs.

Two rheostats, one of the high resistance type and the other of the low resistance type, are used with each tube socket. By means of small pushbutton switches, either rheostat can be connected into the circuit of each tube socket. So, using adapters in the standard sockets provided with the set, the filament current requirements of any standard storage or dry battery tube can be met by connecting one or the other rheostat in the filament circuit tube.

One advantage of the arrangement is the possibility of using either all storage battery tubes or all dry battery tubes in the set, depending on whether it is to be used as a portable outfit or as a home receiver. It is possible also to use different tubes in the different stages of the set.

It is well known that some tubes are better than others for radio frequency amplifiers, while other types are better fitted for use as detector tubes, first stage audio or second stage audio amplifier tubes. With the new circuit arrangement one type of tube can be used for the radio



Arrangement of the new circuit viewed from the top (at left) and from the bottom (above), using tuned radio frequency and regeneration. R_1 and R_2 are 6- and 30 ohm rheostats respectively.

frequency amplifier, another type as the detector, another type for the first stage of audio, and still another type for the second stage. In addition, all tubes of one kind can be used, if desired.

The novelty of the actual wiring in this set lies in the manner in which tuned radio frequency plus regeneration is accomplished.

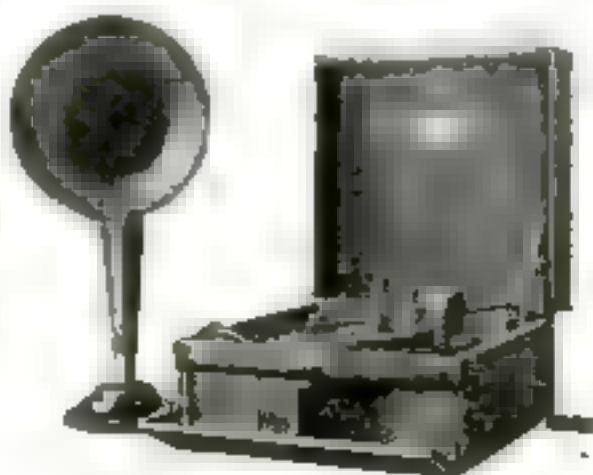
While there are several adjusting controls, there is only one adjustment that is critical, so the set can be considered a one-control set. It can be operated without an aerial, but it gives better results when a good indoor or outdoor aerial is used.

Loudspeakers and Phones Tested by Phonograph

AN INGENIOUS method of testing the comparative merits of radio loudspeakers or head phones by means of a phonograph has lately been devised by Benjamin F. Muenner, a radio engineer of Newark, N. J. The phonograph music is transformed into electric currents by a special type of microphone actuated by the reproducing needle.

The loudspeakers or phones to be tested are connected with the instrument, and a quick change switch permits the musical current to be transferred from one to the other in a fraction of a second. The comparative reproducing qualities of the apparatus under test are apparent instantly. The test is said to be more satisfactory than ones conducted with a radio receiver, because the volume and quality of phonograph music is constant, whereas radio signals may vary continually.

The device has been made portable.



This New Resistance Unit Is for "Peanut" Tubes

WHEN operating the new dry cell tube that consumes .06 amperes, it is necessary to use a larger resistance than the regular rheostat in order properly to cut down the voltage of the three dry cells used in series to provide the proper operating current. For this purpose the resistance unit pictured above recently has been put on the market by a rheostat manufacturer.

By placing it in series with the regular rheostat and filament, the resistance of the circuit can be varied.

This unit also will find numerous applications in the experimental laboratory.



Radio for the Steeplejack

RADIO enthusiasts seem to be wherever there is air and a place to stand or sit. This picture shows how radio followed Michael Bourke, steeplejack carpenter, to dizzy heights in order that his noonday meal might be spiced with melody.

Radio to Join Ford Holdings

THE vast property holdings of Henry Ford, scattered throughout the world, are to be unified by radio. A large broadcasting station, strong enough to communicate across the Atlantic, is being constructed at the River Rouge Ford plant. This latest step results from the successful operation during the past eighteen months of radio and wireless communication between Ford plants throughout the United States and Ford headquarters in Dearborn and Detroit.



Radio Panels from Records

DANCE records of yesteryear that clutter your cabinet need not be thrown away if you are a radio enthusiast. They make excellent radio panels, being of excellent insulating material and easily drilled.

The illustration shows two sets thus fashioned from discarded records. The top view of the panel, at the left, shows the switch points for tuning, the detector and binding posts for phones and the aerial and ground. The bottom view shows the tuning coil and the variable condensers. The completed set is mounted on a round cardboard hatbox, a neat crystal set.

Around the Radio Circuits

with Jack Binns

Third Article: Tuned Radio Frequency and Neutrodyne

This is the last of a series of three articles in which Jack Binns, our radio editor, reduces apparently intricate radio circuits to first principles

SOMETHING about the name, "Tuned Radio Amplification," gives it an air of mystery. To the average fan the name conjures up visions of controls and adjustments that only the expert can master.

To many who have dabbled with the ordinary form of transformer coupled radio frequency amplification, there seems to be no justification for "tuned radio." They cannot see why any one should add adjustable circuits where a fixed circuit apparently will work with supreme satisfaction.

Simplifying "Tuned Radio"

To clear up this question, and to show that "tuned radio" is by no means as complicated as it seems is my purpose in this article, the third of a series designed to explain various types of circuits by tracing their evolution from the original basic hook-up.

Of course, it is an easy matter to say that a thing is not difficult, but it is quite another matter to prove that assertion.

In this case I shall attempt to prove my contention first by considering the very simplest circuit as a means of illustration.

If we place a variometer in series with an aerial and ground, then place a crystal detector and a pair of telephones across it, we shall have a complete radio receiving set that will work over a distance of at least 25 miles.

Let us analyze this circuit and its operation. When we turn the rotor coil of the variometer to a certain position, we hear the speech or music that is coming from the nearest broadcasting station.

Naturally the wave-length range of such a receiver is extremely limited, and will be determined by the maximum and minimum inductance represented by the range of settings on the variometer.

How does such an instrument, so very simple in itself, work satisfactorily? When we have clearly understood this, we shall be able to comprehend the action that takes place in "tuned radio."

In the first place, the electromagnetic waves that surge through the ether from the aerials of the broadcasting station consist of an alternating current wave with a tremendous high frequency. In other words, electricity is passing through the cycle, negative to positive,

and back to negative again at a rate of about a million times a second.

This terrific rate of change is referred to as "radio frequency" because it is far above the range of variation that comes within the audible scale. A wave that is alternating at such high frequency introduces the phenomenon of electrical resonance, and in

that there must be a certain balance between capacity and inductance for every wave length—in other words, for every frequency. All such circuits that combine inductance and capacity are called "oscillatory circuits."

"That is all very well," you may say; "but where do you get the capacity with only a variometer?"

The answer lies in the fact that in every piece of wire there is a quality known as "distributed capacity." If we wind this wire in the form of a coil, and put insulation around the wire, we shall find an appreciable amount of capacity in the circuit represented by the winding.

Variometer Will Help

In this case we obtain our tuning by varying the amount of inductance in the circuit, without interfering with the total capacity of it. Such a method of tuning is practical and efficient. Under such circumstances a variometer is a very efficient tuning instrument, provided too much is not expected from it.

After we have grasped the underlying principles in the action of an oscillatory circuit, we can proceed to an explanation of the difference between

transformer coupled radio amplification, and "tuned" radio amplification.

If we impress an alternating voltage across the grid and filament of a hard vacuum tube, an equivalent of the voltage will be reproduced in the plate circuit, provided the right constants exist in the plate circuit. There will be this difference, however—the reproduction in the plate circuit will be many times stronger because of the amplifying characteristic of the tube itself.

Radio frequency transformers are designed to pass this amplified current along to the next tube for further amplification. In the very nature of things these transformers are designed to cover a fairly large wave-length band. In other words, they must cover a wide range of frequencies, otherwise separate transformers would have

to be inserted in the circuit for each individual broadcasting station.

This being the case, the transformer will be more efficient on the frequency to which it is nearest in resonance than it will on any of the other frequencies it passes. This is a disadvantage that in practice is offset by the fact that the transformers are automatic in their action, and do not require adjustment.

It is in this respect that "tuned" radio amplification is really the most



Complete outfit of parts for building a radio receiver using Prof. Louis A. Haseltine's neutrodyne circuit, shown in diagrams on page 52. Because of the difficulty of winding the three neutrodyne coils properly and of making the small neutralizing condensers, manufacturers now are building these parts complete for amateurs who like to make their own sets.

order to record it we must have a circuit that is capable of resonance.

The primary requirements of such a circuit are inductance and capacity. The former is obtained by means of a coil of wire, the latter by means of a condenser.

The remarkable thing about the circuit is

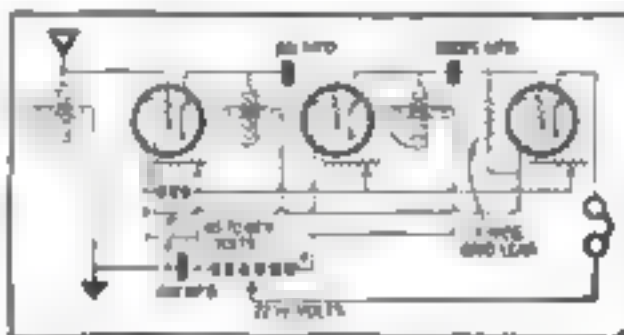
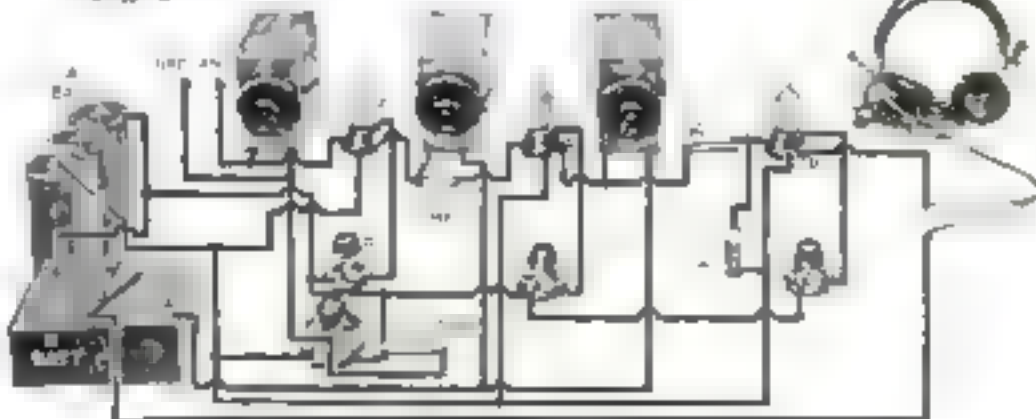


Fig. 1



Tuned radio frequency circuit. R signifies rheostat, P, potentiometer, GC, grid condenser, .00025 mfd. GL grid leak, 1 or 2 megohms. Complete constructional details of a tuned radio frequency unit that can be used with any standard set will be given in next month's Home Workshop Department.

satisfactory, because what we really do with such a system is to tune each of the circuits into resonance with the wave we are receiving. The result is that we obtain the maximum possible amount of amplification, the maximum transfer of energy, from one stage to another, and the maximum amount of selectivity.

The ability to obtain maximum selectivity is apparent. Each stage acts as a sieve, allowing only those currents that are in exact resonance to pass through, and stopping the others. The drawback, of course, lies in the increased number of adjustments necessary.

Now, if we examine various diagrams of simple receivers, we shall observe that in addition to the variometer circuit described in the beginning of this article, we can have a double circuit that can be quite an elaborate affair. For example, it can consist of a variocoupler with a variable condenser in series with its primary winding, and another condenser across its rotor winding. Under these conditions it will have four different tuning elements: First, the setting of the series condenser, second, the number of turns of wire put in use in the primary; third, the degree of coupling between the two coils, and, fourth, the setting of the second condenser.

Similarly the interstage coupling of a radio frequency amplifier can be made simple or complicated, as desired. The more adjustments used, the more accurate will be the resulting tuning, and the more expert will be the handling required. In practice, a multiplicity of adjustment is not necessary. In fact, a variometer in each of the circuits will be sufficient, provided the variometers are designed to cover the wave length band to be received.

Difference Lies in Grid Circuit

Such is the basic system of "tuned" radio amplification, a circuit diagram of which is shown in Fig. 1, on page 81. A glance at the diagram reveals that for all practical purposes the method of coupling the different stages is almost the same as that employed in audio frequency amplifiers.

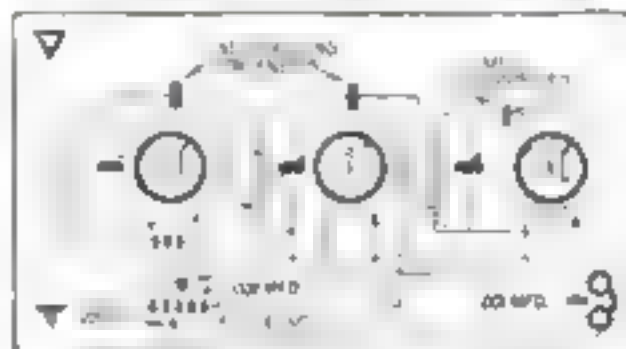
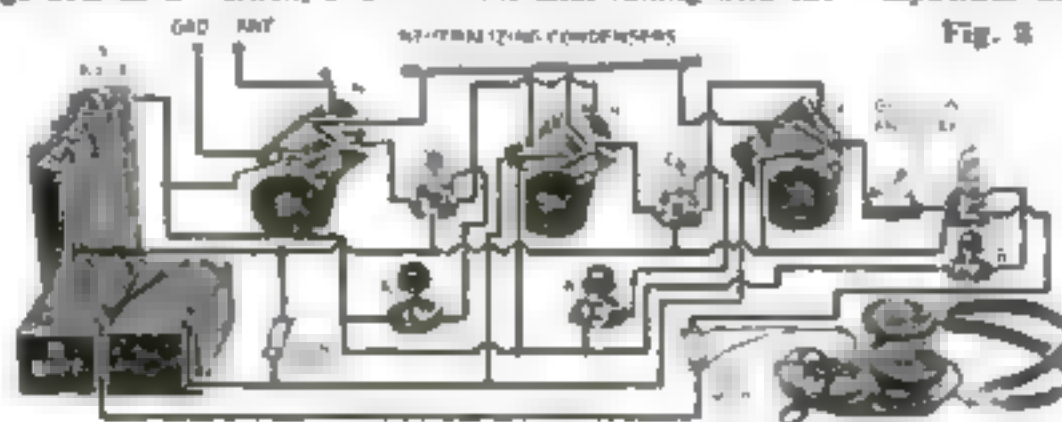
The main difference lies in the grid circuit when a plain variometer is used. In this case the B battery is joined to one side of the variometer. We could not connect it direct with the grid, for if we did so, we should be impressing the full B battery voltage across the grid and filament of the succeeding tube, preventing operation.

This difficulty is overcome by inserting a by-pass condenser in series between the plate side of the variometer and the grid of the next tube. This condenser is a fixed one, and will readily pass the radio frequency currents in the circuit, at the same time effectively stopping the direct current of the B battery from reaching the grid circuit.

If more than one stage of "tuned" radio is employed, and the variometer type of coupling used, it will be found that every variometer actually in a plate circuit can be calibrated for wave length, and settings made accordingly for reception

from any station. To accomplish this, the dials must be fitted carefully to the shafts, so that relative positions of the dial and rotor will remain unchanged.

Under these circumstances, tuning can be accomplished in the same manner that a safe is opened—by means of a combination. The method of procedure is as follows: Set the plate variometers in the same position, and make the final tuning with the



The neutrodyn circuit R signifies rheostat P potentiometer N neutrodyn former coils. Not—positions of neutralizing condensers

serial variometer. When stations have been heard, record the reading of the dials on a chart. The same stations can be found again in the same recorded positions.

Explanation of this simple tuning scheme brings us to a consideration of the most remarkable invention of the year—namely, Professor Louis A. Hazeltine's neutrodyn principle. This system is simply tuned radio frequency amplification, with the squeal removed.

In my article last month I pointed out just how regeneration was present in radio frequency amplification. Unless the transformers are correctly designed, this regeneration is a distinct disadvantage and prevents clear reproduction.

Professor Hazeltine's very ingenious invention eliminates this disadvantage by adopting a well known principle that two

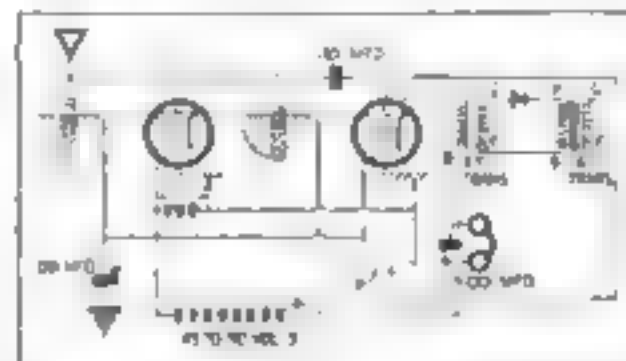
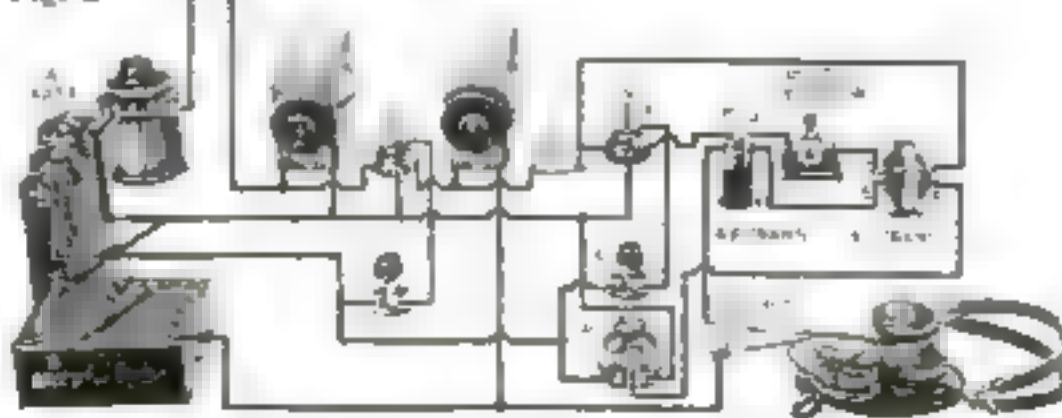


Fig. 3



Combination of tuned radio frequency and reflex circuit R, rheostat, P, potentiometer

equal forces neutralize each other. Now the regenerative action in a radio amplifier is caused by the internal capacity existing between the plate and grid elements inside the vacuum tube. While this capacity is extremely small, it is disastrous under certain circumstances. In the neutrodyn system it is eliminated by pitting against it another capacity of equal value. These two capacities neutralize each other, thereby

Fig. 2

destroying the troublesome capacity effects.

Having achieved this important result, Professor Hazeltine was able to take advantage of other known laws until he obtained a step-up ratio in the windings of the interstage transformers. These transformers have four times as many turns of wire on the secondary as they have on the primary. The result is that in transformation the secondary voltage is stepped up four times, which, of course, gives further amplification.

Another important feature of the transformers is the novel method of tuning them into resonance with the incoming wave. This is done entirely by means of condensers placed across the secondary coils, with the result that the number of controls is reduced. Here the inventor has taken advantage of the laws governing coupled coils. If this coupling is extremely close, the total inductance of both coils will exist in each circuit, so that, while there are actually but 15 turns of wire in the plate circuit, the total amount of inductance will be equal to the total in the transformer.

This novel adaptation of electrical laws permits an efficient coupling of the different stages, and makes it unnecessary to insert any by-pass condensers in the grid circuit of the amplifiers.

An Important Point

An important point to remember in the neutrodyn circuit is that the secondary coil must be wound on the outside of the primary coil. The object is to screen away some of the coupling capacity that otherwise would exist between the primary coil of one stage and the secondary circuit of the preceding stage. Another point is that the transformers must be set at an angle of 45 degrees, at least six inches apart from each other, in order that they will not be in the electromagnetic fields of each other.

These, however, are only variations of the basic system of "tuned" radio. A glance at the diagrams of the two systems will show how both are much alike, and it will bear out the fact that I have tried to emphasize in this series—that all circuits have a definite reason for existence, and that all are based on the same fundamentals.

The third system (Fig. 3), shown on this page is a simple "tuned" radio reflex circuit. In the September article I explained in detail the reflex system. The circuit shown here is unquestionably the simplest of the reflex adaptations. It is one with which we have experimented extensively and which has given very good results both as a distance getter and a volume giver.

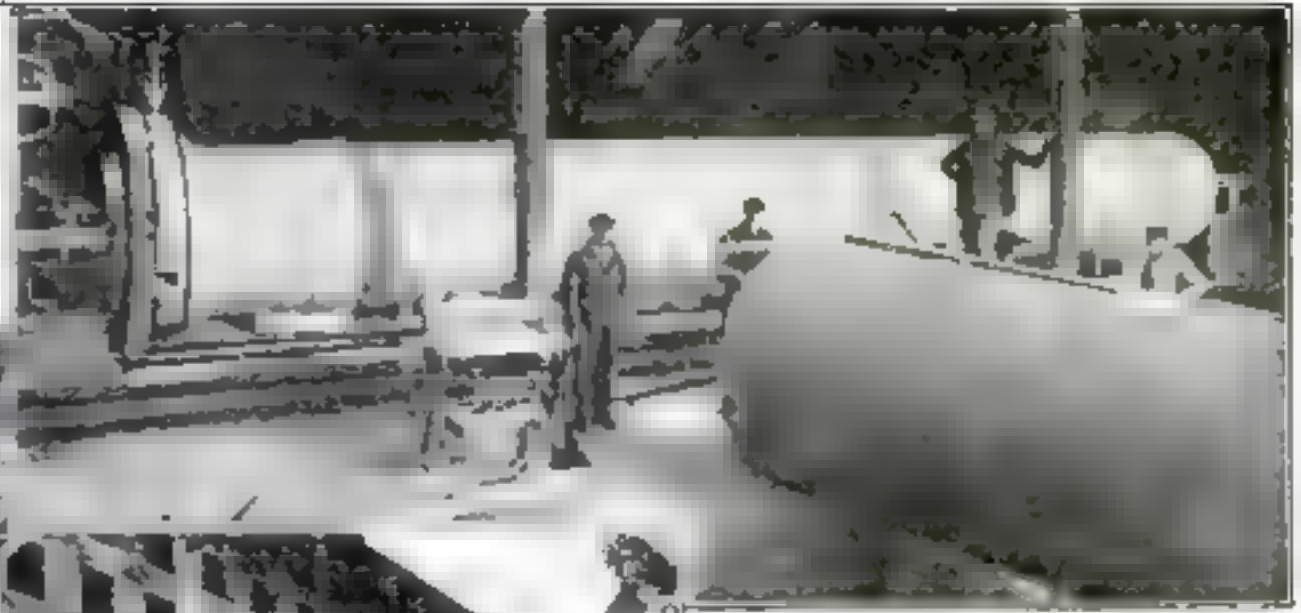
Next month Jack Birna will describe the various types of vacuum tubes used in radio.

Largest Cut Stone Columns of Modern Times

Photograph courtesy Travelers Insurance Co.



Rigging apparatus required by the great size and weight of the columns



A "trimmed" block in the foreground, and a column on the lathe

THE largest single blocks of cut stone quarried in modern times, 36 in number, were erected recently as the columns of the new South Office Building at Harrisburg, Pa. Each of these blocks was five feet in diameter and 33 1/2 feet long, and each weighed, in the finished state, approximately 40 tons.

It is said that the ancients, notably the pyramid builders of old Egypt, quarried and transported still larger blocks.

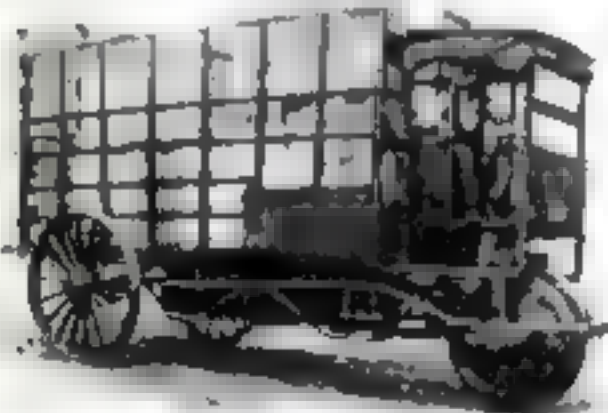
These modern columns are of Indiana colitic limestone. The roughly hewn blocks from which they were cut weighed 90



A column being hoisted to its pedestal (see arrow) on the new South Office Building at Harrisburg, Pa.

tons each. These rough blocks were trimmed, or "squared," by hand tools into a cylindrical shape. By this process the weight was reduced to 75 tons. The final shaping was done on a lathe, specially constructed with considerable ingenuity to accommodate the enormous size of the blocks.

The finished columns were taken on flat cars from Indiana to Pennsylvania, their size and weight making necessary the employment of unusual rigging apparatus when they were lifted into place. It is worthy of note that these columns were quarried, delivered, and erected without damage to property or persons.



This Three-Wheeled Truck Reduces Upkeep Costs

A THREE-WHEELED electric truck that is readily handled in confined spaces and can be turned about in the space on which it stands, has been developed by a Chicago firm.

The truck is driven by the front wheel, inside of which the motor is mounted. The motor pinion engages a circular rack on the interior of the wheel. Steering is accomplished by turning the front wheel, and the connection between the steering column and the wheel is made by means of a pinion on the lower end of the column that engages a circular rack.

It is claimed that the motor and drive mechanisms have been reduced to the simplest form through the elimination of steering knuckles, differentials, chain drives and auxiliary parts. This elimination also reduces maintenance expense and time and labor loss.

The truck was developed originally from a horse-drawn truck owned by the company, for which some use was sought. The motor wheel and battery were attached to the truck and experiments evolved the machine here shown.

Mechanical Marvel Blows Incandescent Bulbs

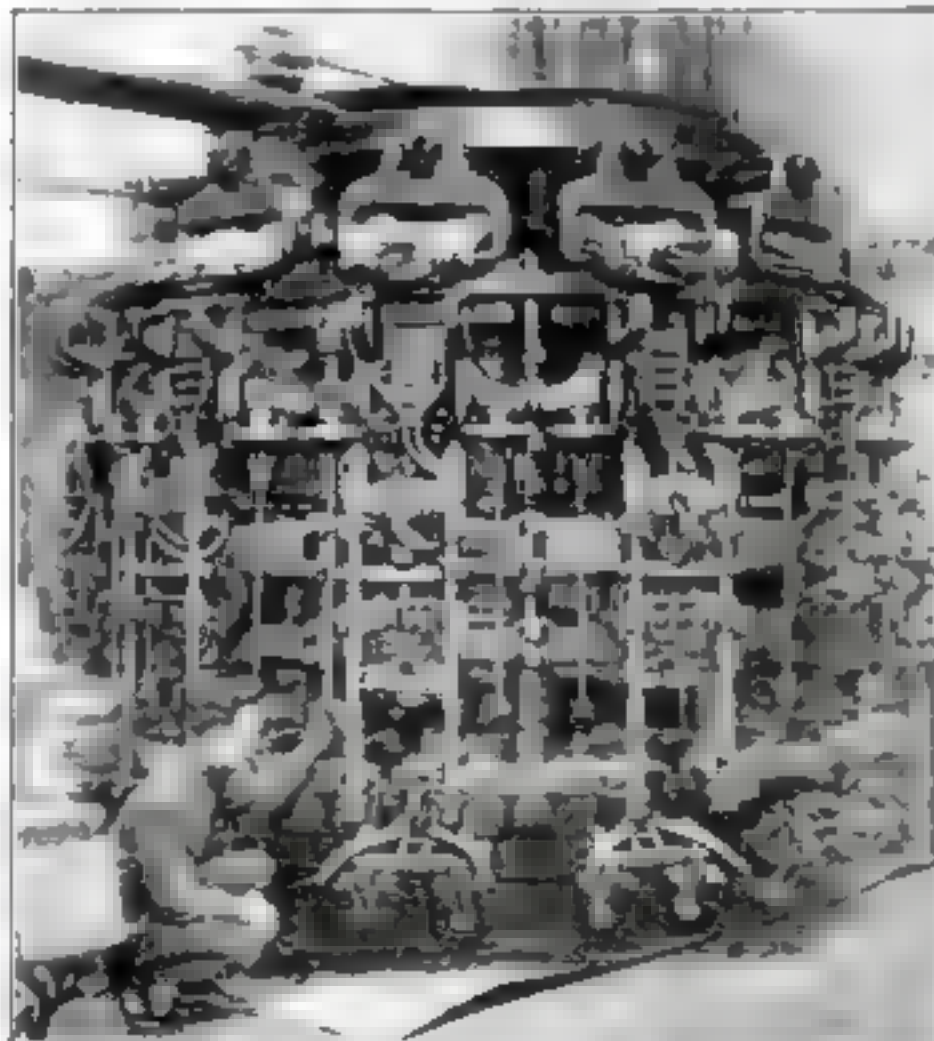
THE remarkable machine shown here, recently installed in the National Lamp Works of the General Electric Company at Cleveland, Ohio, performs all the operations of blowing incandescent lamps, having a capacity of 50,000 bulbs a day. The machine has as many as 14,000 parts.

Twenty-four great arms at its sides reach out and take the molten glass from a tank. A small, sharp knife trims the bubble of glass to the proper size. Compressed air then inflates the glass slightly, and in this condition it is placed in a mold, where compressed air shapes it properly against a

steam cushion. The process is incredibly rapid, perfectly formed bulbs being deposited on a platform an instant after the arms have taken the molten glass from the tank.

An annealing machine, to which the lamps are carried by a conveyor, then automatically removes minor imperfections if its vigilance discovers any. The bulbs are inspected by hand at the end of their journey.

The infinite precision with which so many of the operations involved must be performed makes the development and successful operation of the machine the more remarkable.



This complex mechanical giant, with 14,000 parts, blows 50,000 incandescent light bulbs a day, a task involving infinitely precise operations. Compressed air blows the bulbs

Useful Ideas for Home Convenience



In every kitchen where space is at a premium, this combination kitchen cabinet and refrigerator will be found unusually serviceable. The cabinet is clamped to the top of the refrigerator. Either part of the combination may be obtained separately—icebox or cabinet.



This rapid cruller cutter contains a series of sharp knife edges arranged as to cut the dough in cruller shapes. One complete revolution of the roller cuts 30 uniform crullers.



Concentrating the force of the water, this sanitary flusher drives waste down the pipes of sink or bath.



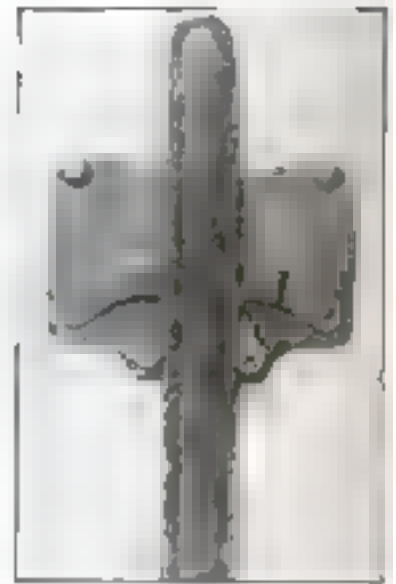
Pots and pans, no matter how hot, may be lifted by means of the device shown above. A lever operated by the thumb spreads the wire wings that grip the edges of the pan.



A novel ash dust remover consists of a smoke outlet pipe terminating in a cover that fits the top of the ashcan. This cover has a slanting chute into which the ashes are shoveled. The outlet pipe runs to furnace smoke pipe.



This handy aluminum egg separator is placed over a cup. When the egg is broken into it, the yolk remains in the cup-shaped center, while the white runs through the circular slots into container below.



An automatic broom holder has an arrangement of two mechanical fingers, tipped with rubber pads, that tightly grip the broom handle when it is inserted.



Equipped with three sets of powerful jaws, a new universal opener is said to remove caps of all sizes. An extension of one of the jaws is a bottle opener.



Designed to remove smoke and cooking odors from the kitchen, this electric ventilator fan can be installed easily in the top of a window. It has a capacity of 500 cubic feet of air a minute.

Cooking Better Food with Less Gas

Uncle Sam's Tests with Standard Burners and Ovens Show How to Save Money and Enormous Quantities of Heat

WOULD you, husbands of America, like to save from 25 to 50 per cent on your household gas bills?

Would you, wives of America, like to help in the saving and at the same time see that the meals you cook, or whose cooking you direct, are prepared scientifically and efficiently?

If so, look to your kitchen gas range and learn its ways; for there lies your chance of achieving both these goals.

Study Your Stove

Your gas range is a mechanical device, not a particularly complicated one, it is true, but still possessing with all other mechanical devices a common characteristic—it can be used correctly and it can be used incorrectly.

Recently in her work as assistant chief of the Office of Home Economics, United States Department of Agriculture, Dr. Minna C. Denton has conducted numerous tests of gas ranges, and as a result of those tests, is in a position to lay down certain easily understood rules for the correct and economical operation of a range. Some of these rules are outlined as follows:

The first thing to be investigated is the flame you use. The hottest flame—which means the flame that will do the most cooking with the least expenditure of gas—is blue; not red, nor yellow, though flames of these colors may appear much hotter. A blue flame—with a tiny tip of yellow—may be obtained by turning the air adjustment device that you will find on the pipe leading from the gas cock to the burner—a device most people neglect entirely.

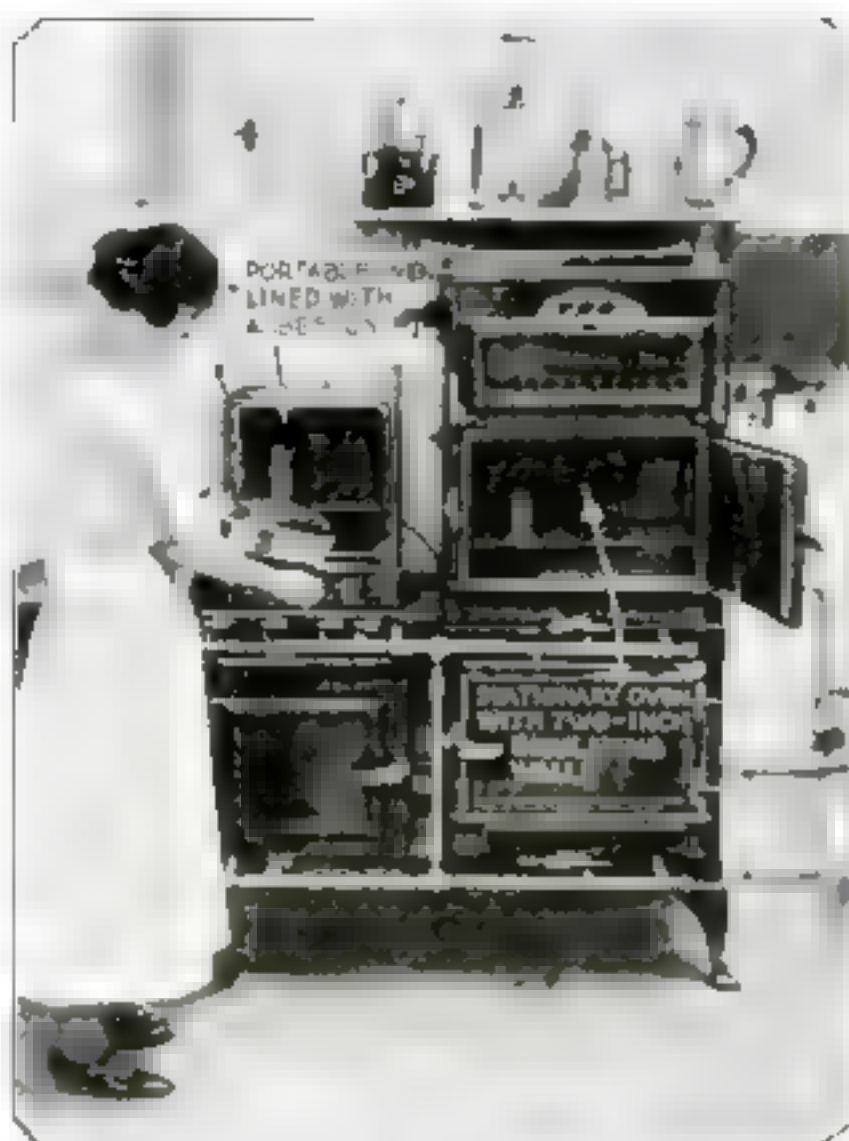
The Blue Flame Is Important

Different ranges will require different methods of adjustment to obtain the proper flame. You will have to experiment to determine how the best flame is to be obtained on your stove; but keep at it until you get the quality of flame described above, for it is a matter of prime importance.

When you have made this adjustment, the next thing to consider is the burner you are to use. The largest burner on your stove consumes probably 50 per cent more gas than the next smaller one, so it is manifestly absurd to use this big burner unless you are cooking a large quantity of food in a large pot.

As a general rule, use a burner of a size that will not permit the flames to lick around the edges of your pot or pan.

Don't fail to use the simmering burner—the smallest on your range. Many housewives never light this burner, which is wonderfully useful in keeping things boiling once they



Tests conducted in Uncle Sam's Office of Home Economics at Washington, D. C., showed that an interlining of asbestos between oven walls will conserve enormous quantities of heat while cooking a meal.

are started on the larger burners. Its use brings about a considerable saving in gas.

Select a stove with burners that will lie not more than from one to 1½ inches below the bottom of the pan. Long flames use much more gas than short ones to produce the same effect.

Be sure that burners are clean and jets kept open.

When food has started to cook, turn down the flame. A high flame is uneconomical and will result in little additional speed in cooking.

Your oven, too, unless it is properly constructed, maintained, and operated by

you, is a constant source of waste. Examine it to be sure that it is tight and doesn't permit the escape of heat. Interlining the walls of the oven with asbestos will conserve an enormous quantity of heat; but, whether you have an oven so constructed or not, be certain that all cracks, especially about the edges of the door, are closed.

Whenever possible, bake at low temperature. You will find that the difference in time between a "fast" oven and a "slow" one will not compensate you for the difference in gas consumption. There are several oven thermometers on the market that will tell you at a glance the exact temperature at which you are baking.

Other Types of Cookers

A fireless cooker will save gas, but only if used properly. Do not overheat the stones. Certainly there is no economy in using as much gas to heat the stones of a fireless cooker as you might use to perform on your stove the same cooking operation.

Pressure cookers also are useful in reducing gas consumption, especially in the preparation of tough meats, vegetables, and cereals. The hooded fireless burner, made by some manufacturers, also is a fuel saver.

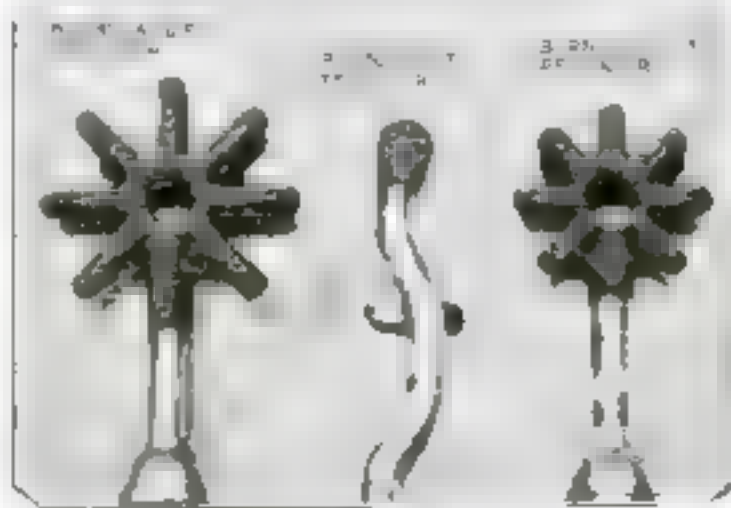
The tests on which Doctor Denton based these rules were entirely practical. Using well-known brands of gas ranges, she actually cooked meat, vegetables, and puddings, baked bread and biscuits, boiled water; in fact, performed with the ranges under test the same operations that housewives all over the country are performing every day. Records were made of the gas consumption and of the time taken to complete each task of cookery.

The results of the tests are the rules here outlined. Follow them, and you will find that they will give a real saving in gas, labor, and food that is properly prepared.

Many Uses for Old Corks

OLD corks can be used in many valuable ways about the house. Spots and blemishes on window glass nearly always will disappear if rubbed with a dry cork. Moistened with turpentine, it will remove marks from hearth tiles or white glaze bricks. Rust spots on metal can be removed by cork dipped in paraffin. Spots on linoleum by cork dipped in gasoline. Burnt marks on pie dishes and plates will vanish if treated with a cork dipped in wet salt.

An effective foot warmer for cold winter nights may be made by cutting corks into small bits, filling a flannel bag with them, and heating for 10 or 15 minutes.



Typical burners of three sizes. The tests showed that the largest burner consumes 50 per cent more gas in cooking than the next smaller one.

Wild-Animal Hunters Save U. S. Millions

Champion, at 70, Has Bagged 500 Lions



A government hunter bringing in a carload of Arizona coyotes

WAS there ever a small boy who did not dream of happiness in the wilderness, surrounded by perils, but downing with each bang of his trusty rifle another leaping, roaring lion?

Ben V. Lily, champion hunter of the United States Biological Survey, was such a boy. And he has just celebrated two anniversaries, one his seventieth birthday and the other the completion of 50 years as a big game hunter.

Wild Beasts Are Plentiful

Lily carries on his story-book career, not in the jungles of Africa or India, but right here in the United States. We might well imagine that development of commerce and the practical application of science in America have eliminated the dangers to life and property from wild beasts. Yet, with the recording of Lily's seventieth birthday the United States Biological Survey chalked up to his credit the bagging of his five-hundredth mountain lion. At the same time official estimates show that his campaigns against predatory animals in New Mexico actually have saved stockmen of the Western states several million dollars a year. Lily hunts with dogs and on one occasion is said to have worn out four packs before bagging his quarry. Another time he trailed a bear 400 miles and killed it.

The story of Lily's remarkable career recalls the fact that there is still a "Wild West," and that even in these days of comfort and security constant battle is necessary against the depredations of savage beasts.

Eighty thousand predatory animals was the bag of Uncle Sam's riflemen last year. They shot, trapped, or poisoned 687 timber wolves, 178 mountain lions, 114 bears, 15 bobcats, and 77,186 coyotes.

Before the army of government hunters was enlisted, the tooth and fang tribute collected annually by the predators amounted to \$1,000,000. In seven years the sharpshooters have killed 380,000 stock-



Captured—a Captain Kidd of the Western plains. Here is a typical prairie wolf stealthy and wise, trapped in his crafty search for livestock prey.

killing beasts, and thus are given credit for saving \$35,000,000 worth of domestic live stock. They are modern Robin Hood men, for they are always ready to answer the call of stockmen and ranchers who report the presence of obnoxious freebooters. There are 266 of them in the Western states.

Among these hardy men, the heir apparent to Lily's title as world champion is Charlie Miller, who killed 20 mountain lions in the first two months of this year. The value to stockmen of this big bag is

shown by the government estimate that each adult mountain lion destroys at least \$1000 worth of live stock every year. To Miller last year went the credit of poisoning a wolf near Flagstaff, Ariz., that had eluded hunters for seven years and terrorized flocks and herds, causing a loss of more than \$10,000.

Some Record Bags

Other government hunters have made record kills in the campaign against predatory beasts. In three hours Lloyd Thompson, a government hunter stationed in Montana, and his dog rounded up and killed five mountain lions.

W. E. Cozens, of Idaho, has won fame as a wolf hunter and has proved himself quite as cunning as the animal he seeks. He dresses in white and glides about on skis during the winter. He steals up on the wily wolves before they detect his presence. Last winter he accomplished the feat of shooting five wolves in a pack in this manner without a miss. Cozens has bagged 80 destructive wolves in the last few years.

One of the 30 government inspectors in the 15 Far Western states tells of a government hunter who bagged five mountain lions and a bobcat in three days.

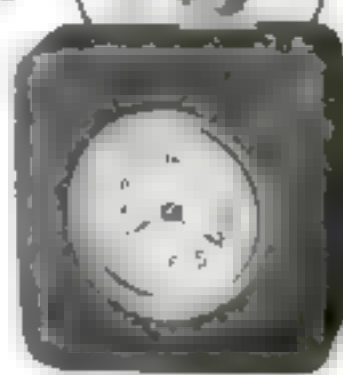
"Some wild animals kill for blood lust only," says W. H. Caywood, one of Uncle Sam's best wolf hunters. "A Rocky Mountain wolf, for example, kills just for the love of killing. Once I saw a pack of wolves drive a dozen cattle over a precipice out of pure devilment."

Coin Clock Saves Money when You Wind It

FOR the benefit of people who haven't learned how to save money, a Cleveland manufacturer has devised an ingenious clock, which requires winding every 24 hours, but which cannot be wound unless a nickel, a dime, or a quarter is dropped in a slot to release the spring.

The clock is small, 2½ in. in width but, if its possessor keeps it running, its capacity is sufficient to add many dollars a year to his savings account.

The clock has found wide use among banks of the Middle West, which use them to encourage thrift on the part of new depositors.



Above, Setting traps for coyotes. At the left is Ben V. Lily, American champion big game hunter who at the age of 70 has killed 500 mountain lions.



Can Your Jaws Lift Jack Dempsey?

By Arthur D. Black, M.D., D.D.S.

Dean of Northwestern University Dental School

POSSIBLY you are aware that the human jaw is very strong. You have seen circus performers swinging from trapezes or raising enormous weights by the grip of their teeth. But do you know that the muscles of your own jaw develop and increase by the necessary work you perform in chewing? Our jaws possess power enough to lift from the ground a man as large as Jack Dempsey?

Tests of the jaw power of many thousands of persons offer some surprising facts regarding the strength of the average human jaw. A person of normal strength and with useful teeth can exert more pressure between his back teeth than he can produce by any other part of his body. The bite of the jaw is stronger than the grasp of the hand, the pressure of one hand against the other or the grip of the knees. It is greater than the weight of the whole body of any but exceptionally heavy persons.

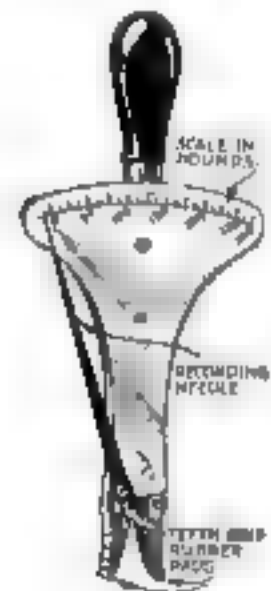
The average jaws possess a biting power of 171 pounds, the jaw strength of thousands of persons examined varying between 25 pounds and 280 pounds. The figure of 280 pounds does not, however, necessarily represent the maximum power of the jaw.

The instrument by which the power of the human jaw is measured, called the gnathodynamometer, is constructed to register no higher than that figure. Doubtless many persons can bite as much as 300 pounds.

Just how great a force 260 pounds is can be realized when I say that it is equivalent to the greatest weight the average man can lift from the floor with one hand, using his back, legs, and every other muscle to aid him.

The strength of the bite as registered on a recording instrument depends not so much upon the muscular power of the person being tested as upon the condition of his teeth. This condition depends upon the habitual use of the teeth. We give advice that most of us receive early in life is responsible for the fact that we shrink from attacking with our teeth hard substances that would yield to them regularly.

A normally healthy child will attempt to chew almost anything that appears to be edible. It will crack nuts and gnaw on hard candy and its teeth will suffer no harm. On the contrary, the tissues supporting the teeth will be strengthened and hardened as those of an animal are hardened from chewing on bones and other hard substances. Misin-



This device measures jaw strength

formed elders, however, will warn the child against this instinctive use of the teeth for the purposes for which they were designed. The result is that the child acquires fear of biting on hard objects, and its teeth, lacking the exercise they need, do



© K. B. Stone

The acrobats teeth had formed and player



a pressure of 100 pounds, and three or four minutes of work increased the strength of their bite to 150 pounds.

Years ago in the West, hazel nuts with tough skins requiring between 100 and 150 pounds of pressure grew wild and people cracked them with their teeth. These same

nuts are cultivated and cultivated now, requiring only half as much jaw force. Yet many few people would dare attack them with their teeth.

As I said, we should use our teeth freely on hard foods. It is a commonly expressed fancy that teeth which have been treated in this way are spoiled. This is not true. If the teeth work has been done properly, the filling will be more secure and will stand a pressure of from 125 to 150 pounds. This is the greatest force the jaws ordinarily will be called upon to exert.

The toughest beef will yield to a grinding force by the teeth of from 70 to 90 pounds. Better cuts of beef may require as little as 45 pounds pressure from the

jaws. Mutton may be chewed with a force of between 30 and 45 pounds. Roast veal requires from 35 to 45 pounds, pork from 30 to 35 pounds, corned beef from 30 to 35 pounds, and broiled ham from 40 to 60 pounds. Among meats, cold boiled tongue can be chewed with the least expenditure of jaw energy, between three and five pounds sufficing.

To those who may fear to break their teeth by biting on hard substances, let me say that, provided their teeth are in good condition, they will not be harmed by small bones or stones, birdshot or similar materials that accidentally may get into the food. Tests conducted on a specially constructed dynamometer show the teeth to be much stronger than any of these materials.

Freshly extracted teeth placed in this machine resisted much stronger pressure than stones, metals, and other substances which the average man would regard as being considerably harder than his teeth.



Gus Lewis, strong man of Brighton Beach, N. Y., bending and breaking a thick iron spike with his teeth. The spike was embedded eight inches in a wooden beam.

How Much Power Do You Use when You Eat?

"THE toughest beef will yield to a grinding force of from 70 to 90 pounds," says Doctor Black. "Mutton may be chewed with a force of between 30 and 45 pounds. Roast veal requires from 35 to 45 pounds, pork from 30 to 35 pounds, corned beef the same, and broiled ham from 40 to 60 pounds."

not receive the thorough scrubbing which results from vigorous mastication.

I have seen many persons, who, accustomed to chewing only on soft foods, have registered a bite of only 30 pounds under test. A change of diet, which included a fair proportion of hard foods, worked wonders with these persons. Within a month their teeth were capable of exerting

Oiling and Greasing Your Car

Costly Repair Bills, Even Accident or Death, May Be Penalties of Neglect

By F. A. Platte

*Instructor, Department of Physics,
Columbia University*

RECENTLY I found a neighbor stalled by the roadside. His machine was in the ditch. His clothes were covered with mud. He was white and shaking.

"The steering gear broke and I was nearly killed," he said. "Only the soft mud of the bank saved me."

I went over and looked at his car. A steering knuckle had broken.

"If you had called your car properly, this never could have happened," I told him.

"Oil?" he said in surprise. "What has oil to do with it? Besides, I filled my crankcase just before I left the garage. Even now the gauge shows it nearly full."

I picked up part of the broken knuckle. It had worn thin. "When did you oil your steering apparatus last?" I asked.

"Oh, I never did that," he replied.

That neglect nearly had cost him his life. Because of the lack of oil, the constant friction on the steering knuckle had worn it thin. It had snapped suddenly under a quick strain.

But how many motorists oil their steering gears or any working parts other than those of the engine? Not many. That is why automobile manufacturers are fairly correct in their estimate that 75 per cent of all repairs and 50 per cent of all depreciation is due to inadequate lubrication.

When you receive your car from the dealer, all parts are well greased and oiled. Ask him then what oil to use in the crankcase at each season of the year. Different makes of cars require different types of oil. He will tell you the particular needs of the car you purchase.

* The crankcase is the most important single oiling locality because from it are oiled all the working parts of the engine interior. Always keep it full—your gage will tell you when it is—but avoid flooding. A heavy white or blue smoke from your exhaust means too much oil.

After running about 500 miles, drain all the oil from the crankcase by unscrewing the plug in the bottom, generally near the rear, and letting the oil run out. Before refilling with clean oil, remove the gum and other sediment. Do this by putting about a gallon of kerosene through the filling tube after replacing the drain plug. Then, with the ignition off to prevent starting, press the starter button and allow the turning motor to splash the kerosene about. If you have no starter, use the crank.

Now remove the drain plug again, giving the starter a few turns while the kerosene is running out. Then fill your crankcase with new oil. About every 1000 miles this refilling operation should be repeated. Inspect your crankcase every day.

The misconception that all lubrication centers in the crankcase is the greatest

cause of depreciation. Although the crankcase takes care of all moving parts of the engine interior, about 40 other places on the average car need oil or grease. These should be inspected and lubricated regularly.

Parts needing attention weekly are the spring shackle bolts, steering gear, fan bearing, and brake mechanism. The shackle bolts are at the ends of the springs and from them is suspended the chassis. At the ends of the bolts you will find a grease cup or grease gun fastening. If cups, fill them and give them two turns every day or so; if grease gun holes, force in heavy grease until the old black grease comes out through the joints.

You will find an oil hole near the steering wheel which will lubricate the connection with the steering column. Next, grease or oil the reach rod clevis bolts, reach rod ball and sockets and the worm gear. Where there are grease cups, do as you did for the shackle bolts. Where there are oil holes, drop in some light lubricant from a can.

The fan bearing needs a few drops of light oil through the oil hole.

Follow the brake mechanism through the car each week, injecting a reasonable amount of light lubricant at the several joints. The emergency brake should be treated similarly.

Where the front



Where most clemens never explore—the auto's fan bearing

wheels are connected with the axle, you will find the steering knuckle usually with a small oil cup. Keep this filled with oil, not grease. Lack of lubrication here causes wobbly wheels.

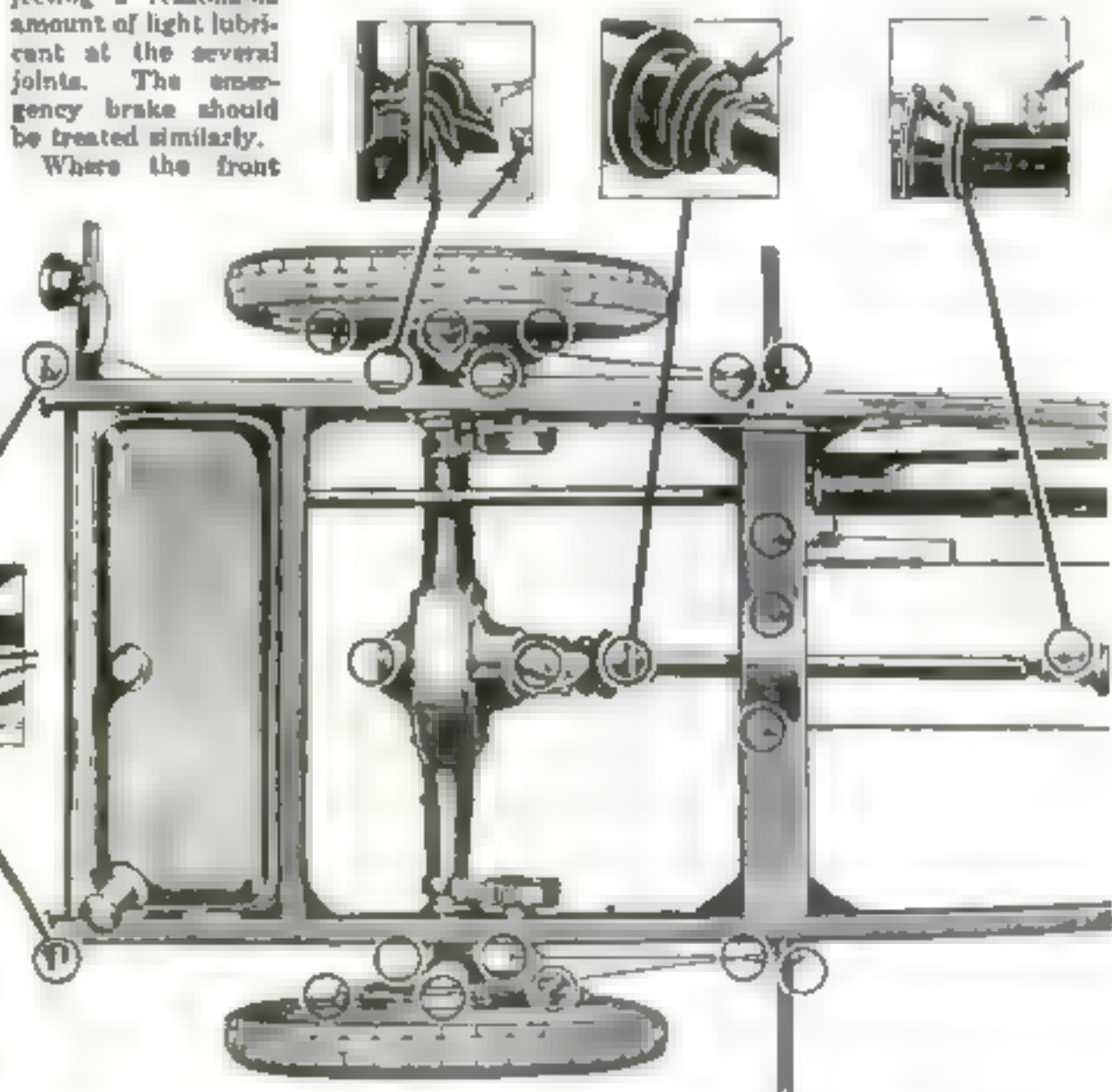
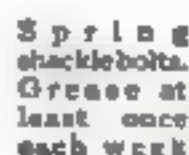
So much for the weekly lubrication.

Every month the rear shaft bearing, universal joints, transmission rear support bearing, clutch, generator, distributor, and

Rear axle shaft bearing and emergency brake can create monthly

Rear universal joint. Grease at least once each month.

Front universal joint.
Grease at least
once a week



Just Where and How to Grease and Oil Your Auto

The above diagram illustrates graphically the precise locations of those vulnerable points where grease and oil can save you

money, inconvenience, and sometimes serious accident. Most of these strategic points are ignored by the average car owner.

starting and horn motors should be looked to.

Usually there is a grease cup on the rear axle shaft bearing, just outside the frame near the brake bands. Fill this with the kind of grease used for the spring shackle bolts. When lubricating this part inspect the axle housing to see if oil is running out on the brake bands. If so, have the joint made tighter.

Next come the two universal joints at the end of the long transmission shaft connecting the gearbox and differential in the rear. A fibrous grease made for this purpose should be forced into the grease cups here. Behind the gearbox is the transmission rear support bearing, which requires oil, not grease, monthly. Here you will find usually a capped oil hole.

The clutch mechanism should be followed through and all working parts and bearings lubricated with a medium oil. The clutch throw-out bearing has a cup needing heavy grease.

Among parts likely to escape attention because of inconspicuous or not easily accessible location are the generator, usually near the fan, the distributor, from which rubber insulated leads go to the spark plugs; and the starting

and horn motors. Use a few drops of oil wherever there are oil holes, taking care not to flood the distributor parts.

Every three months, you should clean out old oil and grease, and lubricate the remaining parts of the car. Put a little heavy grease or graphitic oil on the starter chain.



Don't forget your starting motor and generator

gear case with a heavy grease.

The plug in the transmission case, behind the shifting lever, should be removed and the case filled with heavy transmission oil or light grease. Treat similarly the differential housing on the rear axle, filling up the cases to the level of the oil holes.

It is important that the oil and grease in these parts be not too heavy, since the rapidly rotating parts have a tendency to throw the material out against the case. A heavy grease will be thrown against the walls and stick there, leaving a hole in the center in which the operating parts rotate without any lubrication. This will soon cause wear, and new gears will have to be supplied.

A long walk on a hot, dusty country road once impressed on my mind the importance of proper lubrication in the differential. I had gone driving with a friend. When we were about six miles from the nearest town, something broke. The car stopped with a grinding sound. We made an inspection and found a small pinion in the differential had broken, due to lack of lubrication. The grease in the housing was too heavy and had been thrown away from the gears so that they were left hot and dry. My friend and I had a long walk to town.

But in avoiding too heavy grease, take care not to get it too light. The consistency of the lubricant should be such that it will run slowly but should not be so light that the film will be too thin to supply proper greasing.

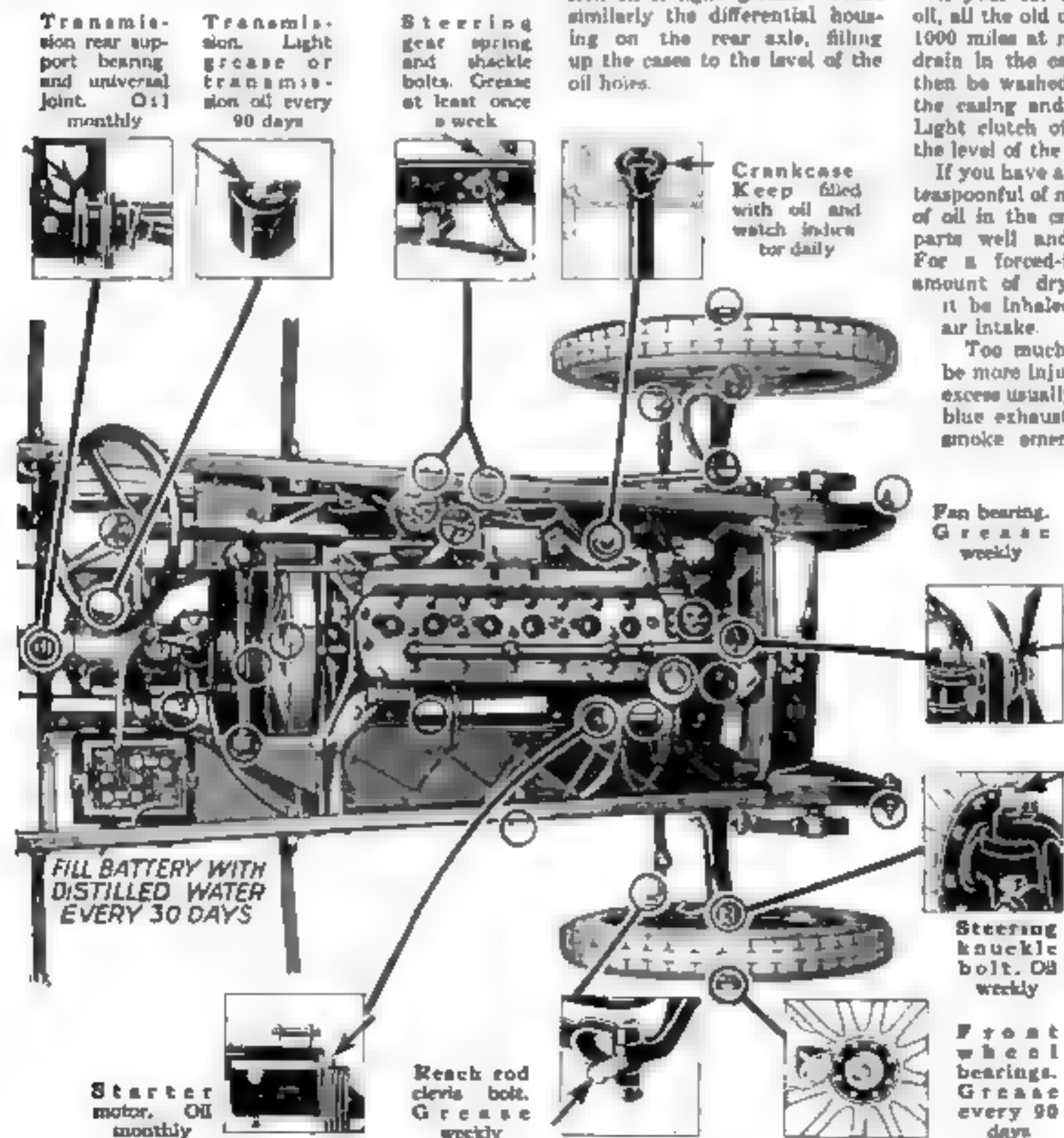
If your car has disk clutches requiring oil, all the old oil should be removed every 1000 miles at most. Do this through the drain in the casing. The clutch should then be washed by pouring kerosene into the casing and allowing it to drain dry. Light clutch oil then should be put into the level of the bottom of the clutch shaft.

If you have a splash-feed system, a scant teaspoonful of motor graphite to each quart of oil in the crankcase should polish the parts well and greatly reduce friction. For a forced-feed system use a small amount of dry graphite weekly, letting it be inhaled through the carburetor's air intake.

Too much oil in the crankcase may be more injurious than too little. This excess usually is indicated by white or blue exhaust smoke. Sometimes the smoke emerges in single puffs, indicating that only one cylinder is flooded. Whenever this occurs clean the spark plugs.

The purchaser of a car should study the oiling chart shown here and should ascertain the type of oiling system used in the new automobile, for no time is better spent than that consumed in securing proper lubrication. If you want your car to last, you must give it the attention that engineers bestow upon the engines of the power plants that supply your home with electricity and that locomotive drivers devote to the care of their power unit.

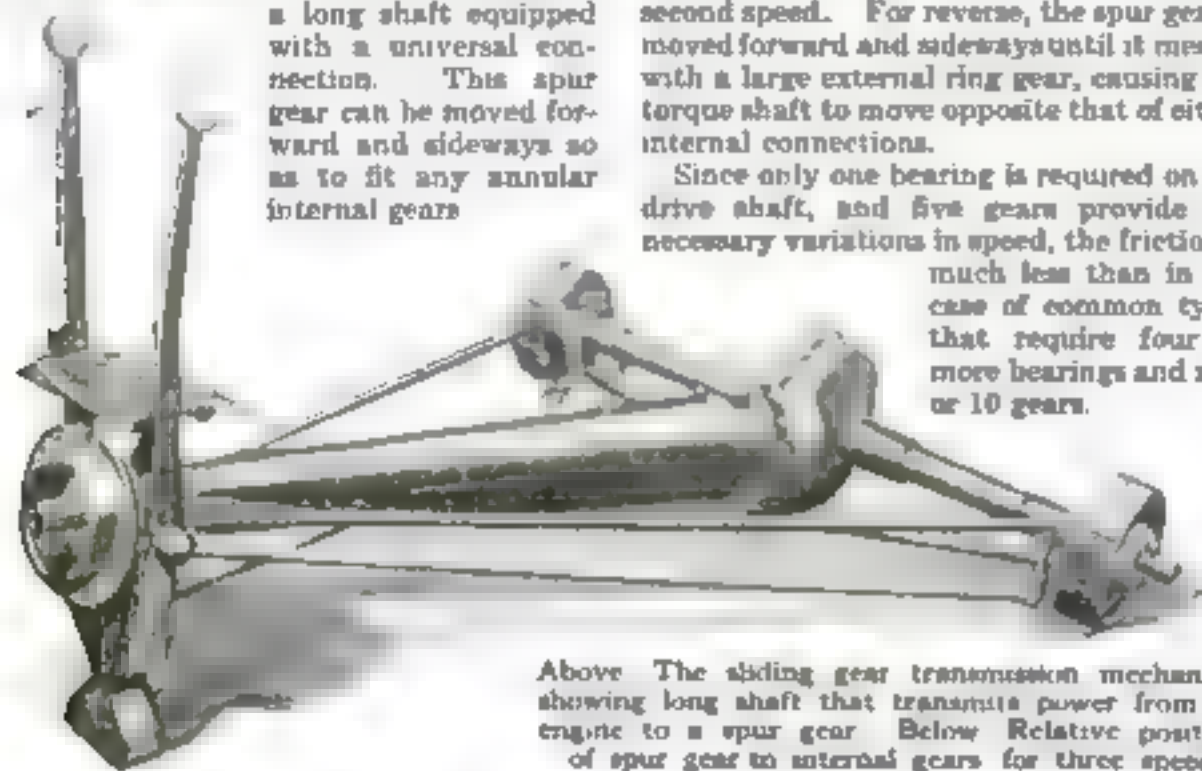
Finally, remember always that friction is the worst foe of your automobile and that lubrication is the worst foe of friction.



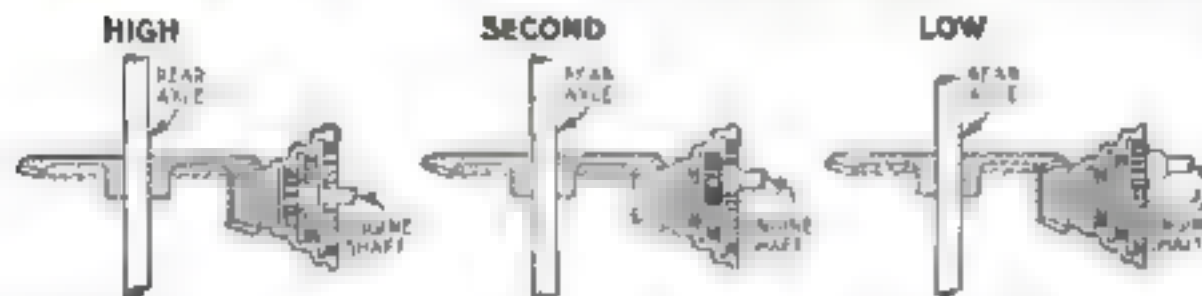
Sliding Gear Simplifies Transmission

A SLIDING gear automobile transmission of a radically new type has the advantage of eliminating most of the gears and bearings that make up the present complicated transmission mechanisms.

Power from the motor is communicated to a spur gear near the differential through a long shaft equipped with a universal connection. This spur gear can be moved forward and sideways so as to fit any annular internal gears.



Above The sliding gear transmission mechanism, showing long shaft that transmits power from the engine to a spur gear. Below Relative positions of spur gear to internal gears for three speeds.



When the spur gear is meshed with the largest of these, the differential gears turn most slowly, thus giving low gear. When meshed with the smallest gear, the drive shaft is in direct line with the differential shaft, and as a result high speed is obtained.

An intermediate ring gear provides second speed. For reverse, the spur gear is moved forward and sideways until it meshes with a large external ring gear, causing the torque shaft to move opposite that of either internal connections.

Since only one bearing is required on the drive shaft, and five gears provide the necessary variations in speed, the friction is much less than in the case of common types that require four or more bearings and nine or 10 gears.



New Sidelights for Autos Prevent Accidents

HOW many times would an automobile headlight providing a generous side ray have spared an accident along country roads at night?

Such a lamp has been invented. It throws a wide flood of illumination to the side of the car. Two of the lamps on an open or closed car can be moved at the will of the driver to throw their rays in any direction. They are controlled by a switch on the dash.

Efficient Tire Hand Pump Prevents Waste Effort

THIS new revised tire pump, said to deliver more air with fewer strokes than any other hand pump on the market, has been perfected by a Kansas manufacturer.



The unique construction of the plunger and barrel is said to eliminate waste compression, to insure all the air from the barrel going into the tire at each stroke, and to make it impossible to pump oil into the tire.

The absence of a screw cap on top of the barrel eliminates another feature objectionable to automobile drivers.

Know Your Car

The Generator and Its Circuits

YOU may know that the generator on your car supplies electricity for the ignition, starting and lighting systems; but do you know how it is connected with the rest of the circuit?

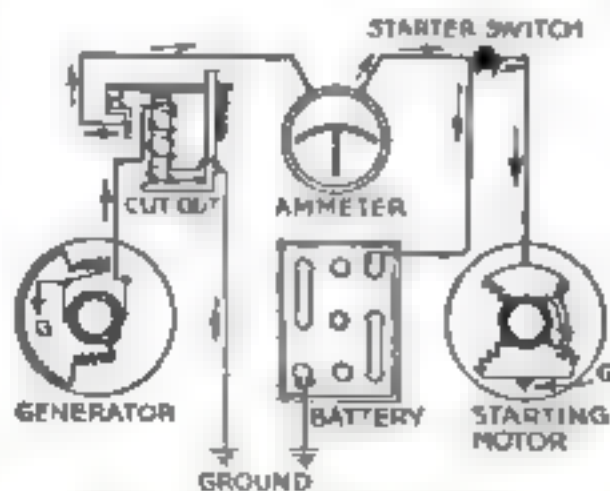
The generator itself is shunt wound, that is, a part of the electricity produced is shunted through the coils that provide the magnetized field through which the wires of the armature cut. The remainder of the electricity passes off on a wire to the cut-out. This cut-out serves to prevent the stored energy of the battery from dissipating itself by running back to the generator while the engine is stationary.

When the generator voltage has reached 6.5, which occurs when the car is traveling eight miles an hour in high gear, the cut-out points are brought together under the action of a temporary magnet. The current then can flow through the cut-out to the ammeter, which indicates that the battery is charging. Upon passing the ammeter, the circuit is broken, one part going to

the battery and the other to the starter switch. The break is made at this point so that the current used to turn the starting motor will not pass through and burn out the ammeter. The starting motor requires from 120 to 250 amperes, and the usual ammeter is designed to carry only 30 amperes. Since the generator can produce only 22 amperes, it is necessary to utilize the stored energy of the battery for starting.

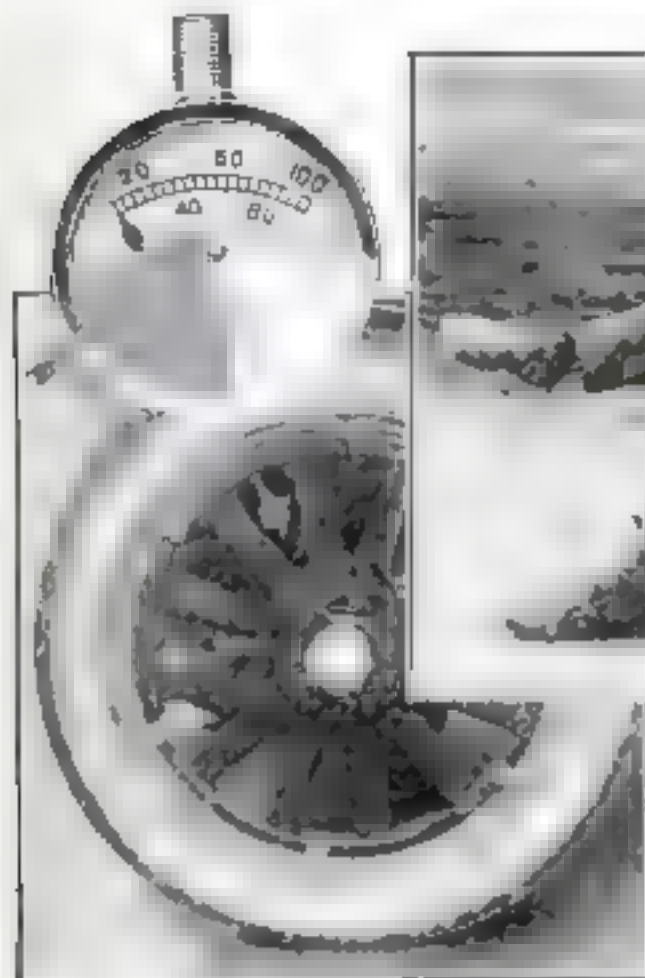
There are several complete circuits in the system. One terminal of the generator is grounded and one wire of the cut-out is grounded. Thus a complete circuit is formed whenever the generator operates, even though the cut-out points are separated. Then, too, the battery is grounded, forming a complete circuit—cut-out, ammeter, battery, and through ground back to generator.

One terminal of the starting motor is grounded to provide the return whenever the starter switch is thrown in.



How generator fits into circuit

More Service and Convenience from Your Car



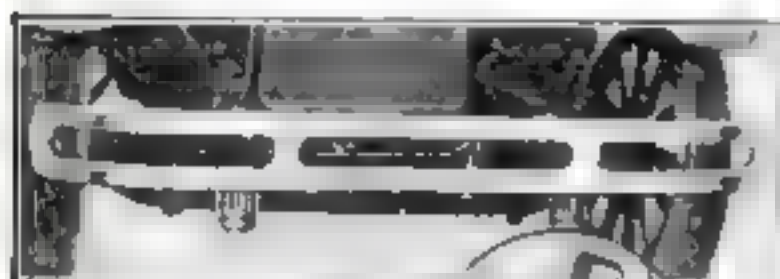
One of these gauges on each tire will tell the air pressure at any time, eliminating the use of a pocket gage and the removal of the tire caps.



When in danger of striking a pedestrian the driver is warned by a special lamp. As the lamp drops, a canvas tender unit is to catch the pedestrian.



Inserting a locknut in a hole bored and threaded through the lower part of motorometer flange is said to obviate rotting washers, to keep the crossbar in line, and to baffle thieves.



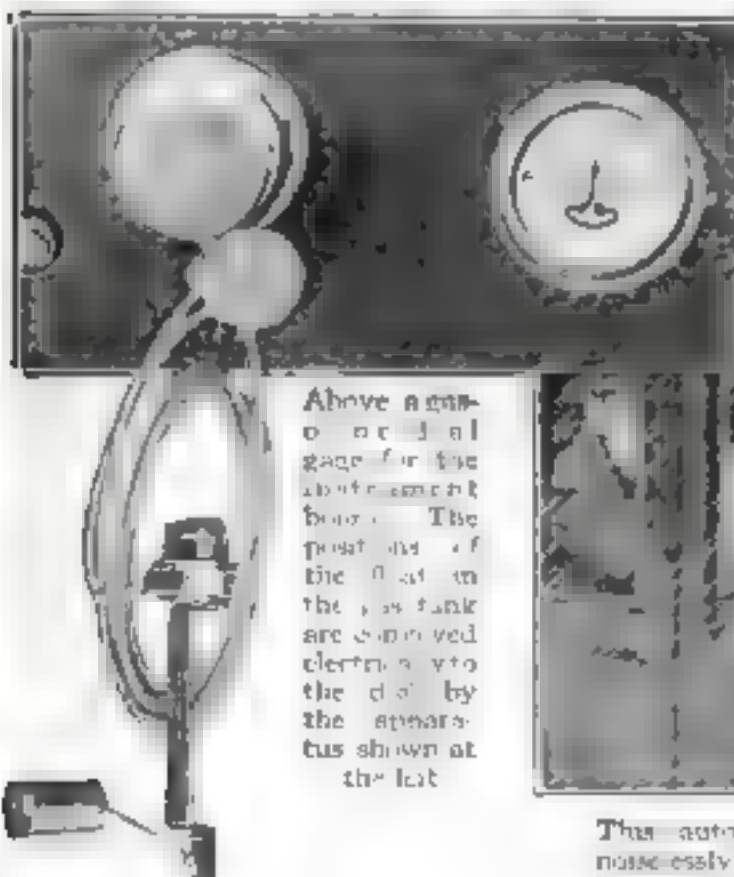
This flexible bumper, designed to absorb the shock of impact with yielding and springs instead of meeting it with the rigidity of most bumpers, is said to minimize the consequences of slight collisions. Inset, one of the cord springs.



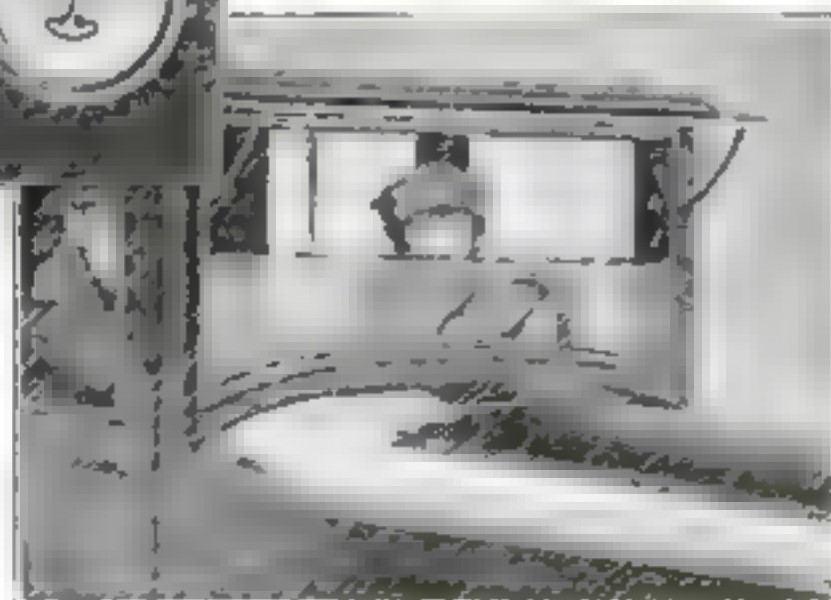
The foot accelerator shown above, at left, is said to maintain an even gas flow on rough roads. Above: How the pedal, which cannot be pushed down until the feed button is pressed, frictionally keeps the flow constant. Withdrawing the foot will retard the gasoline flow.



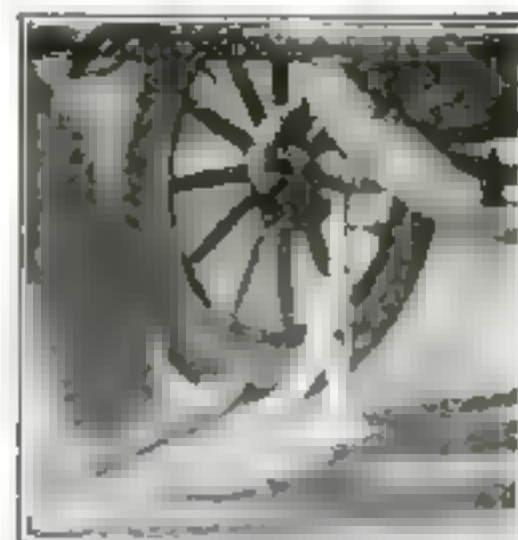
A new hot spot for Ford manifolds (at left) absorbs heat from exhaust and directs it against the intake, into which inertia will throw all unvaporized fuel.



Above a gas-oil level gage for the motor compartment. The position of the float in the gas tank are conveyed electrically to the dial by the apparatus shown at the left.



This automatic traveling cleaner rod operated noiselessly by the motor's vacuum, clears the entire length of the windshield and so affords complete driving vision, no matter what the weather.



With this jack, pressure on a pedal lifts a light car. The device keeps the hands clean and avoids many injuries.

Inverse Duplex Set Will Double Amplification

By Joseph Calcaterra

OF POPULAR SCIENCE MONTHLY'S
Radio Staff

THE Flewelling set described last month represents the highest development of the simpler radio circuits using a single vacuum tube. This month I am describing the construction of a more elaborate receiver, which uses two vacuum tubes and a crystal detector, and in tests has given exceptional results for a two-tube set.

Those who read Jack Binns' story on radio frequency and reflex circuits in the September issue will have little trouble in understanding the theory and operation of the circuit used in this set. It is, indeed, practically identical with the inverse duplex circuit explained in that article, with the exception that no condenser is used across the secondary winding of the tuning unit, a single rheostat controls the filament current of both tubes, and a battery switch has been added so that the A battery may be disconnected when the set is not in use.

This switch is important because it prevents running down the A battery uselessly through the potentiometer connected across the battery terminals.

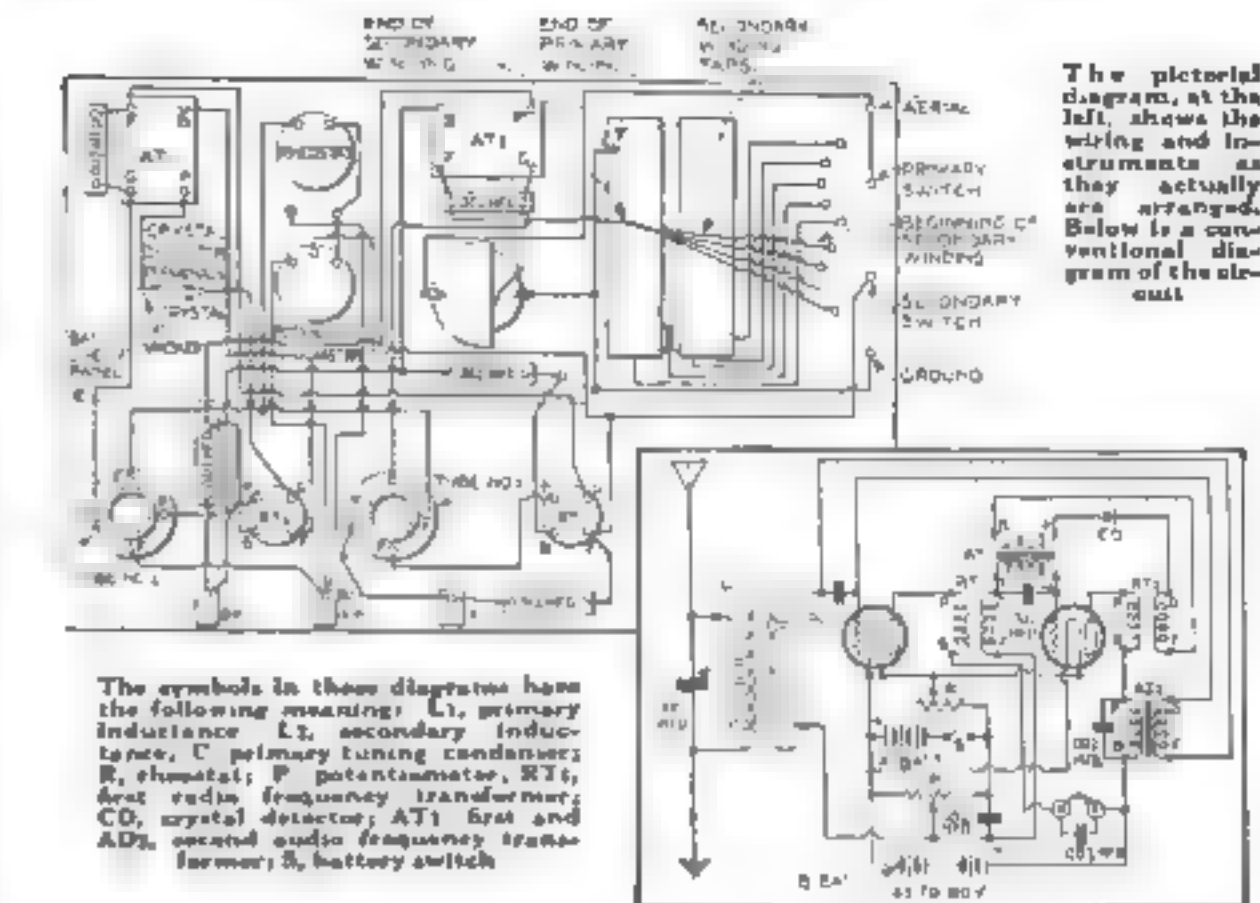
The tuning unit is made by splitting the stator and rotor windings of a standard wooden variometer of the hollow shaft type having about 40 turns on both the stator and the rotor. The stator winding is then used as the primary, while the rotor winding is used as the secondary.

How to Obtain Closer Tuning

To provide closer tuning in both the primary and secondary circuits, the windings are tapped, six taps being taken on the primary winding and five taps on the secondary winding. This is done by disassembling the variometer, lifting the wire where a tap is to be taken, and drilling a small hole from that point to the outside of the stator or the inside of the rotor. The lead can then be inserted from the outside and the end carefully soldered to a bare portion of the winding. The wire is then forced back into place, care being taken that the tap has been made so that it will not make contact with adjacent turns and short circuit them.

The right-hand half of the winding, known in the picture diagram as the secondary, is divided into three sections as possible into three sections. The left-hand end is divided into two sections. The joint where the halves of the winding are soldered together is taken as another tap, so that, counting the outside ends, there will be six taps in all. The leads from these taps are connected as shown in the picture diagram, five of them going to the primary switch, while the sixth connects with the ground post.

The secondary winding is tapped so that four of the leads go through the hollow shaft to the secondary switch points, while the fifth is connected with the F terminal of audio transformer No. 2. The leads should be left long enough so that there is



The symbols in these diagrams have the following meaning: L1, primary inductance; L2, secondary inductance; C, primary tuning condenser; R, rheostat; P, potentiometer; AT1, first radio frequency transformer; CD, crystal detector; AT2, first and AD2, second audio frequency transformer; S, battery switch.

no tendency for the wires to act as springs and prevent the smooth operation of the rotor.

Provision should be made for a stop on the rotor shaft to prevent the rotor from being turned through more than one revolution. If this is not done, the leads from the secondary will soon be twisted and weakened, the insulation damaged, and the circuit rendered inoperative by short circuits. The wire used for the leads should be of the flexible variety, obtainable at practically any electrical supply store.

If the constructor does not care to use the tapped variometer type of tuning unit, he may use instead any standard or home-made type of variocoupler. In that case,

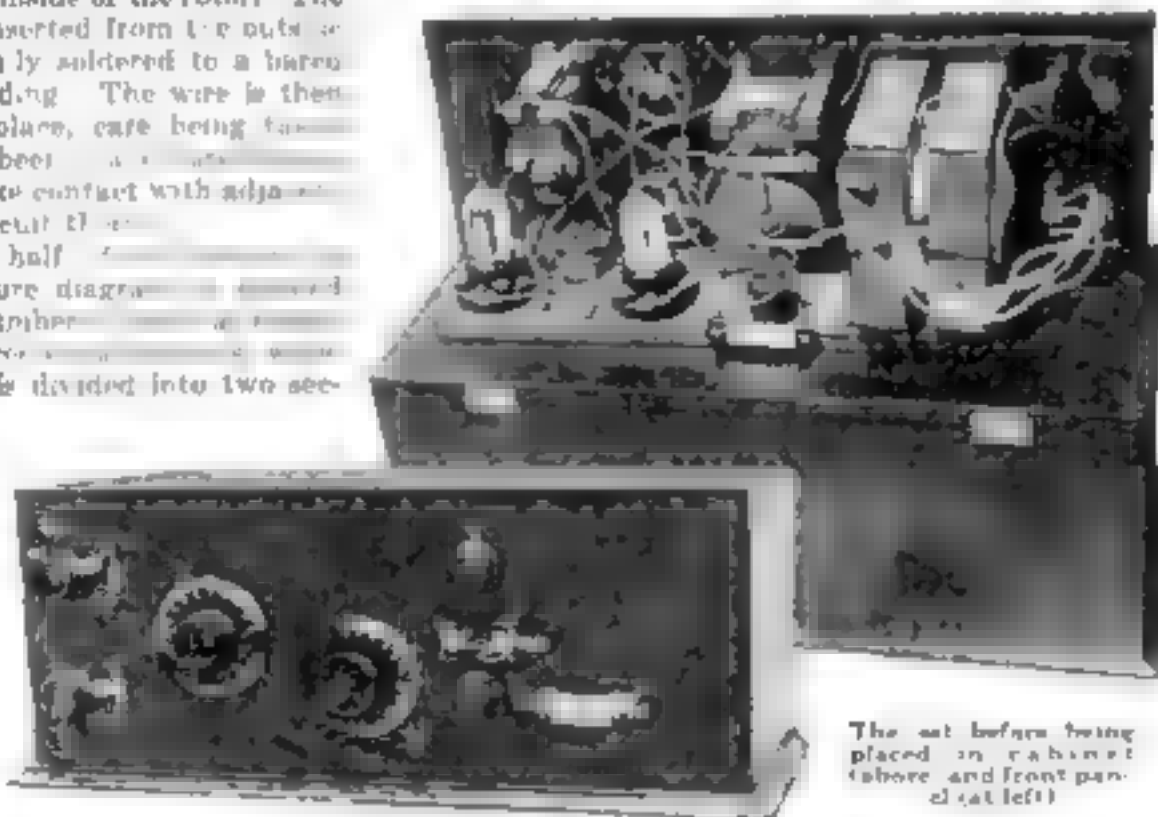
It is, of course, impossible to give exact dimensions regarding the placing of the parts on the panel and in the cabinet, as these dimensions depend considerably on the type and size of the parts used in making the set. In making the set illustrated, however, a 7 by 18 in. panel was used, so that if you use a panel of this size, with a cabinet of corresponding proportions, you will have no difficulty in placing your instruments in the same general positions as those shown in the photograph. In this set the three 1½-volt batteries for the filament current and four small B batteries go inside the cabinet. This makes a compact, self-contained receiver.

The operation is very simple. After closing the battery switch, the rheostat is adjusted so that the tubes are burning fairly brightly. By varying the adjustment of the tuning elements of the set and testing various spots on the crystal with the catwhisker, a spot will soon be found that is sensitive and brings in one of the broadcasting stations that happens to be "on the air" at the time. Once this adjustment is obtained, no further attention to the crystal is necessary and it can be left at that adjustment until such time as it should be jarred accidentally from its position.

Once the sensitive spot has been located, any desired station can be brought in by the usual manipulation of the tuning elements and by a proper adjustment of the potentiometer. Then the rheostat can be reset so that the current flowing through the filament

is as low as possible consistent with good results.

If clear reception is not obtained after you have made all possible adjustments, you may try grounding the catwhisker side of the crystal detector circuit. This expedient will often bring in the station, but it should not be tried unless the set does not respond to the other adjustments.



The set before being placed in cabinet (above and front panel at left).

the primary coil of the coupler can be tapped in the usual way by the use of a tap and a wiper switch and the variable condenser can be used across the secondary of the coupler instead of across the primary coil. Where this is done, however, it is desirable to use a Vernier condenser of three plates, if possible, across the primary winding in order to get close tuning.



The Home Workshop

Arthur Wakeling, Editor

How to Rebuild a Broken-Down Car

NO MATTER how little money he has to spend, the man who is mechanically minded and has a genuine enthusiasm for automobiles never need be without a smoothly running and good looking car.

What can be done in remodeling a broken down car is strikingly illustrated at the right. The car shown is a 1918 model of a roadster six, built by a good manufacturer. Although subjected to hard use and some abuse, it was still in fair running condition when it went into the ditch and was reduced to the unattractive wreck of the lower illustration. It was bought for \$75, which was high, if anything, and remodeled at a cost for materials of \$185.15. This included paint, top, and tires.

This was not a freak performance; any wide-awake mechanic interested in automobiles can do as well. In fact, it is often possible to buy a car for less and put it in running condition at a smaller expenditure. It is even easier, however, to pay as much or more for a used car and never be able to make anything out of the machine.

Had the battle in remodeling a used car is, indeed, to pick out one that can be put into good shape easily at low cost. To make a wise purchase is of primary importance, and nothing but disappointment awaits the mechanic if he does not choose a car strictly on the basis of the repairs necessary to reconstruct it.

Year after year hundreds of thousands of used motor cars are placed upon the market, but only a certain proportion of them are worth buying for remodeling. Special precautions and unusual methods must be taken in selecting a car.

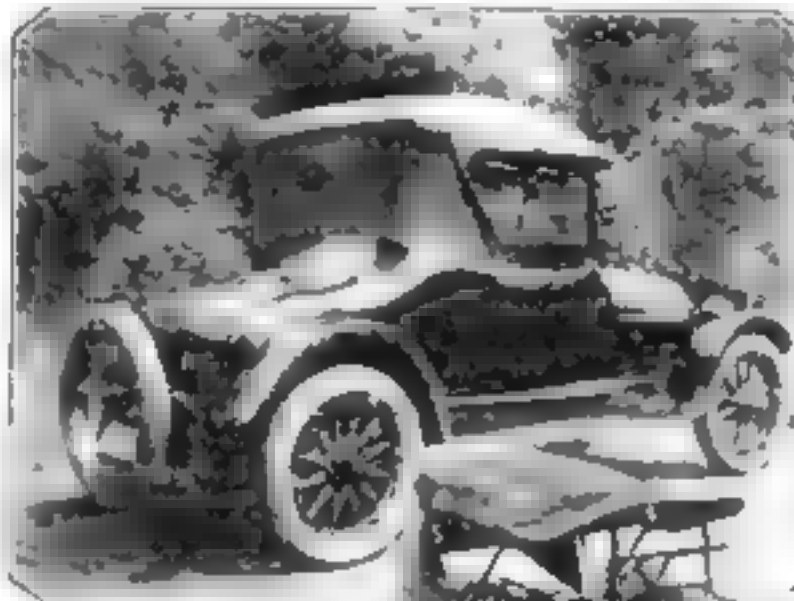
First of all, look at a number of cars before deciding to buy. What you must look for is a solid frame, an engine having no scored cylinders, a starter that works, generator that shows signs of being healthy, bearings that are not too noisy; in other words, a good power plant.

Start your search by inquiring among friends whether they know of a used car for sale. Then, too, it would be well to make the round of the secondhand dealers. While their cars usually are fixed up to

By Ray F. Kuns

Principal, Automotive Trade School,
Cincinnati, Ohio

THIS is the first of a series of three articles on how to remodel a used car. Next month Mr. Kuns will tell how to overhaul the rear end, the transmission, and clutch.



The used car before and after the remodeling. The car was literally picked out of a ditch.



strike the eye and may have engines of doubtful quality, one can sometimes obtain a good one. At any rate, you will get an idea of the average prices.

The question of size plays an important part in the price of secondhand cars. There is a greater market for the smaller ones and hence the price is proportionately less for the larger models. Furthermore, one should purchase a make of car for which repair parts can readily be obtained. Obsolete makes are very cheap, but don't be tricked into buying one you cannot repair because of the difficulty of obtaining replacements.

Looking Over the Mechanism

Having found a car that comes within the price range and will answer your needs as far as size is concerned, take up the all-important consideration of the mechanism and the possibilities of repairing it.

First, are the cylinders and piston rings in good condition? Leaving off the ignition, turn over the engine very slowly with the hand crank. Note whether or not the compression reaction in all cylinders seems to be about the same. In a four-cylinder engine, if three are strong and the fourth is weak, try to learn which one is defective. If there is a hissing noise as the com-

pression escapes, it may mean a scored cylinder or bad piston rings. In that case, ask permission to remove the head and inspect the cylinders. If a cylinder is scored, leave the car alone; but if only the piston rings are worn, these can readily be replaced.

Another way would be to have the owner run the engine for you. If there is a hissing sound emerging from the breather tube, take a look at the cylinders, for it would indicate that the compression was leaking into the crankcase.

How about the generator? If, while the engine is running, the ammeter on the dash indicates that the battery is charging, you do not have to worry about the generator.

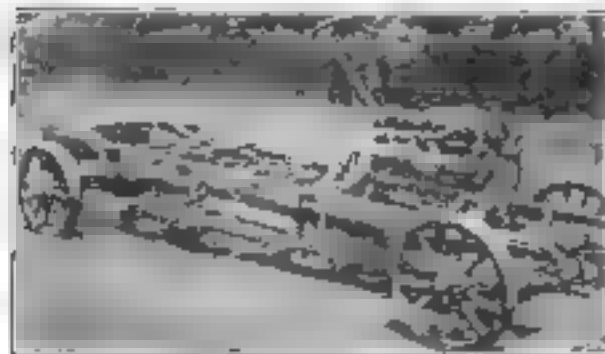
Take a look at the pump shaft and other exposed drive parts to see how they run. There may be some place there that will impair the efficiency of the engine. Listen to the valve lifters and, if overhead valves, to the rocker arms. Is there any play that causes rattling?

If the self-starter is operated from the flywheel, remove the inspection plate and take a look at the teeth. Very often these become ground down through long operation and poor lubrication and eventually such worn teeth will break and leave you without a starter.

How about the radiator? See if it holds water and whether or not the pump throws water into the top tank when the engine is speeded up. If it does not flow down through the radiator core properly, it will fill the upper tank and overflow, indicating that the core is stopped and may have to be renewed.

And how are you going to determine the amount of play in the transmission system? Just jack up one of the rear wheels, throw the gearshift into high with the engine stationary and turn the jacked-up wheel as far as it will go. If the wheel does not rock more than 4 or 5 in., the parts probably are good. If the wheel rocks a quarter turn, inspect the universals and propeller shaft and see if you can locate the play there.

There should not be too much play in the
(Turn to page 119)



The chassis stripped and ready for a thorough cleaning.



The frame stripped, cleaned, and ready for inspection.

Making the Most of Your Home Workshop

WHEN polishing with an emery cloth, the holder shown in Fig. 1 is more satisfactory than a flat file.

The cloth is cut the right width and the ends are folded and slipped into the diagonal slots. The abrasive is then tightened by screwing the windnut.—G. A. L.

IN THE middle of a job, when the need for a surface gage came up unexpectedly and no gage was available, the serviceable substitute illustrated in Fig. 2 was quickly put together. The parts used are a 1½-in. brass pulley with a ½-in. hole, a length of ¼-in. steel rod, an old brass screw with a large hexagonal head, a piece of ¼-in. tool steel, and two thumbscrews with milled heads.

One end of the ¼-in. rod was pressed into the pulley and the other was drilled, so that the threaded part of the brass screw could be passed through. The milled nut holds the screw in any position in which it is turned. Through the head of the large screw was drilled, from side to side, a hole to take the ¼-in. rod used as the scriber. Another hole was drilled to meet it and tapped for a 6/32 machine screw to clamp the scriber in place, bending one point before tempering.—H. G.

FOR workbench drawers and other drawers that are better for having flush handles, and where appearances are not important, leather serves very well for the handles. Simply cut a cavity about 3 in. in diameter with an expansion bit and tack a semicircle of leather over the upper half of the hole (Fig. 3). If the edges of the leather are inlaid in the wood, the job will be all the neater.—THOMAS W. BENSON, Philadelphia, Pa.

IN A home workshop where the tool equipment is limited, the bit brace may be used for simple turning, coil and spring winding, and other work that requires slow, heavy, positive rotation.

The brace is mounted in wooden supports, high enough to permit the handle to be turned freely, as shown in Fig. 4. A simple tool rest can then be made, and, if desired, a clamp for holding and feeding a tool against the work.

Two cones arranged to slide on a rod that can be gripped in the bit chuck, will serve to hold various sizes of cylindrical forms for radio coils. With other fixtures that can be devised as required, the bit brace will act as a turning machine for the occasional job

that otherwise cannot easily be done with hand tools.—L. A. G.

TOOL handles that are cracked or fractured can often be repaired so as to give good service, especially if the damage is checked in time. A split file or chisel handle can be reinforced by a twisted ferule of soft wire. One end of the wire is laid in a groove cut in the wood and, when the winding is completed, twisted with the

slid back and forth along the wire while the grinder is being turned.—M. C. MURDER, Silver Creek, Neb.

A HOLDER made of soft wire, as shown in Fig. 7, is a time-saver in starting small screws in tapped holes that are difficult to reach.

The head of the screw is placed between the two loops and gripped by drawing back the sliding cross piece.—A. C. L.

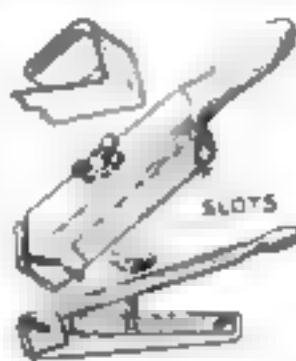


Fig. 1. Emery cloth holder

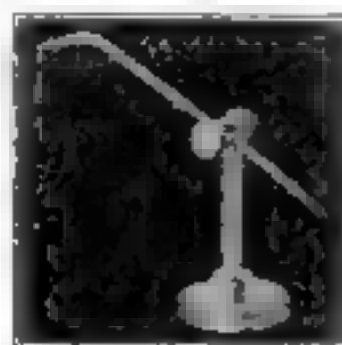


Fig. 2. Surface gage

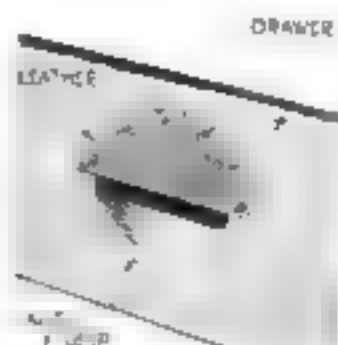


Fig. 3. Drawer handle

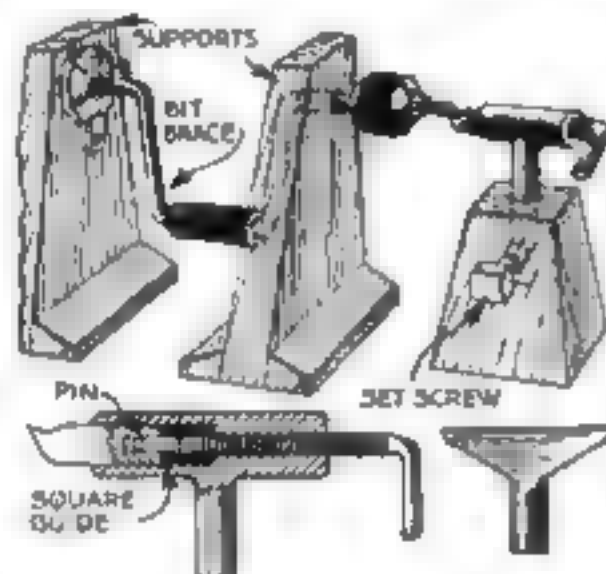


Fig. 4. Bit brace for turning

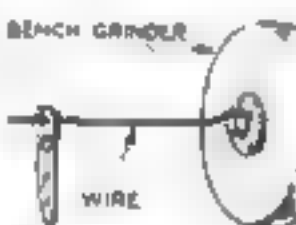


Fig. 5. Enlarging small holes



Fig. 6. Screw holder

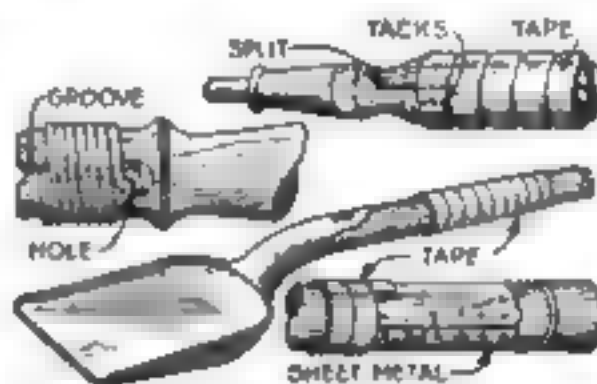


Fig. 7. Methods for repairing tool handles

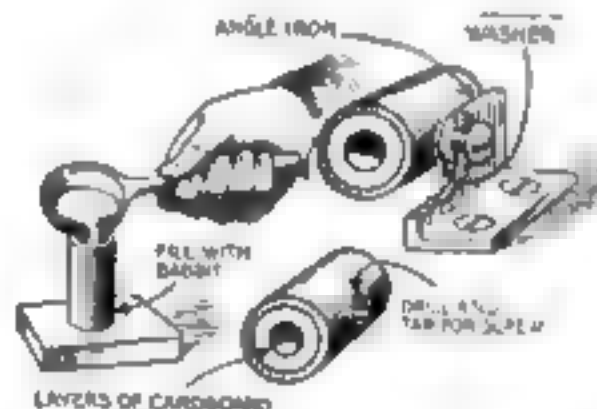


Fig. 8. Small universal bearings

other end, as shown in Fig. 5. The loose wire is then cut off, and the butt forced down into a drilled hole and filed off smooth.

Every one tapes a screwdriver handle, but the tape persistently comes loose unless the end of the last turn is folded and fastened with very small tacks.

A shovel or even a pick handle that is split may often be repaired. File down the wood for a distance of 3 in. on each side of the split to a diameter of ½ in. less than that of the handle and tack a sheet of brass or other metal tightly over the cracked part. Wind tape on top, extending it beyond the ends, to make as smooth a reinforcement as possible.—JOE V. ROMIG.

AN ORDINARY hand grinder can be used in the home workshop for enlarging a small hole in tempered steel (Fig. 6). A length of iron wire of a diameter that will just slip through the hole, is bent into a ring at one end. This eye then is turned at right angles so that it can be fastened to the grinder spindle by means of the wheel locknut. Valve grinding compound is applied to the wire, and the piece to be reamed is

for working brass, but with all the angles somewhat less acute, and see that they are as hard as fire and water will make them. The speed of the work should be quite slow as compared with that used for turning brass. Particular pains should be taken to keep the point of the tool always cutting; do not allow it to scrape along the surface without taking a bite, for it will then act as a grinder and rapidly wear off the edge. Do not take too heavy a cut, although that is better than to scrape without cutting. No matter how hard the tool may be, it will require frequent sharpening.—H. C.

FOR filing a finish on a small flat surface, one of the best ways is to lay the file flat on the bench and move the job over it instead of attempting to keep the file in one place while moving it across the work held in a vise.

With but little care a very true surface can be produced. An excellent type of file for this is what is known as an "equaling" or "parallel" file, which has no taper. A smooth-cut file is much better for small work than the coarser cut files.—L. P.

SMALL machine bearings that can be mounted on surfaces of almost any shape and that are adapted to all sorts of positions, can be made quickly from ordinary gas- or water-pipe. Obtain pipe about ¼ in. larger than the shafting for which the bearing is to be used, and saw off pieces 1 in. long or longer. Fill each with babbitt, place it in a lathe, face it off and drill for the shaft. Next, drill and tap a 3/16- or ¼-in. hole, as shown in Fig. 8, and mount the bearing on a short length of angle iron. Many combinations of bearings and angle irons are possible, and the construction is strong enough for light work.—C. F. KLINGER, Pittsburgh, Pa.

HARD fiber is exasperating stuff to work on the lathe, chiefly because it so quickly spoils the cutting edge of a tool. Grind the cutting tools as

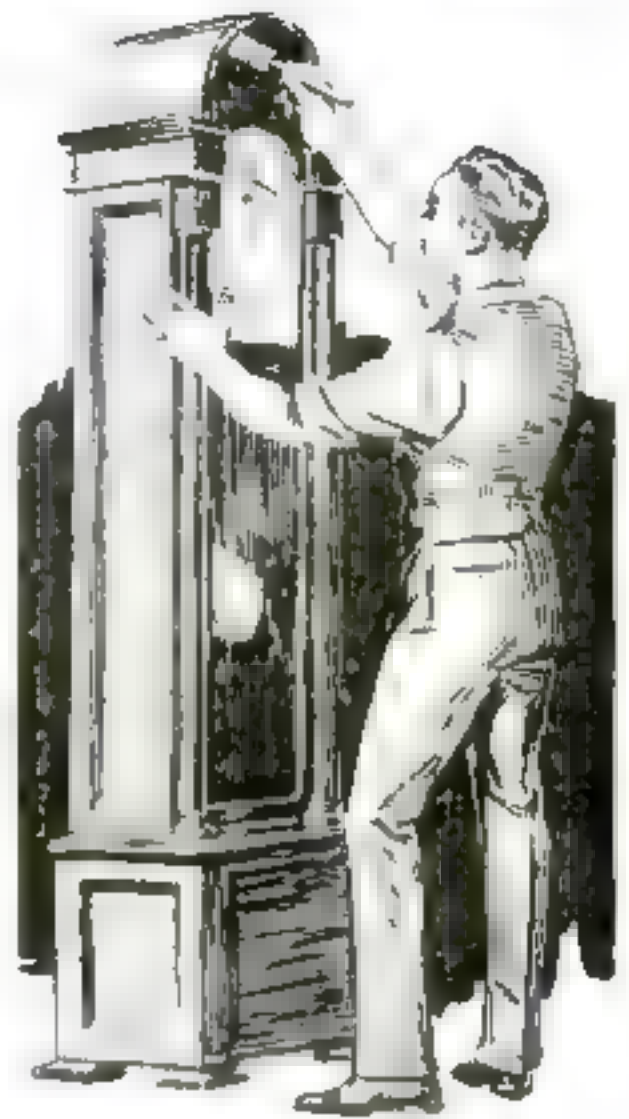
The Proper Finish Will Make Your Furniture Harmonize



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127 Brown Mahogany	123 Dark Oak
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How to Build Serviceable Tables Quickly

By Leslie W. Lyon

AMATEUR woodworkers who have had little experience or cannot spend much time in their home workshops, often do not care to attempt making mortise and tenon joints, or even plain doweled joints. These workers will find useful the type of table construction shown in the accompanying illustrations.

This method of joining table frames was first suggested to me by an old mechanic and since then I have used it for making all sorts of tables—library tables, large dining tables for porch use, writing tables for the summer camp, and, finally, a play-room table for the nursery.

The advantages of the construction are that the entire table is made from $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{1}{2}$ -in. stock, that only the simplest screw joints are used, that the table can be knocked flat in five minutes for shipment or storage, that an ordinary carpenter can build one from plain lumber within two



A library table with a lower shelf made of $\frac{1}{2}$ 8-in. stock throughout

one or more nails at each end driven at a slight angle toward the center. The rails are then attached to the legs with screws driven in from the inside.

If the table is a large one, it is advisable to connect the lower rails with a shelf. This shelf may simply be screwed to the top edges of the lower rails or to cleats that have previously been screwed to the inside

of the rails. A neater method is to mortise and tenon the shelf into the end rail, as shown in the center illustration above.

The boards forming the top are held together with three cleats. I have never fastened the tops directly to any of the tables, but merely have placed the end cleats edgewise in such



The general table construction is shown above and the joint details at the right

hours, and that the finished table is neat, strong, and durable.

Each leg is made of two pieces nailed together with finishing nails. Holes should be drilled for the nails, especially if hard wood is used, and, if a thoroughly durable job is desired, the joints should be coated with thin glue before nailing. A nail is first put in the center of the leg and then

a position that they fit just inside the top end rails of the table. In fastening the cleats to the top, I use large round-head screws, first boring holes edgewise into the cleats to let the heads of the screws in about an inch and then boring holes for the screws the rest of the way of such a size that each screw will have a little play. This allows for any expansion or contraction of the boards. A single screw run through the cleat and into the end rail at each corner will hold the top in place, if thought necessary. It is, of course, imperative to use screws and not nails for all the joints except those connecting the long, tapered boards used as leg members.

Any type of finish may be used. The library table illustrated is oak, stained, shellacked, and waxed. The play table is birch, carefully sanded and finished with two coats of flat white paint and ivory enamel, the last coat being rubbed with finely powdered pumice stone and water.

The porch dining table, not shown, was



A play table made of birch and finished in ivory enamel rubbed smooth with pumice stone

painted white on top with bright green legs and frame. This table and several ordinary kitchen chairs painted in the same color combination, make an attractive summery looking luncheon set. The table itself, although about 6 ft. long, is taken apart at the end of the summer, and stored very compactly in the attic.

Magnet Changes Telephone into Sensitive Loudspeaker

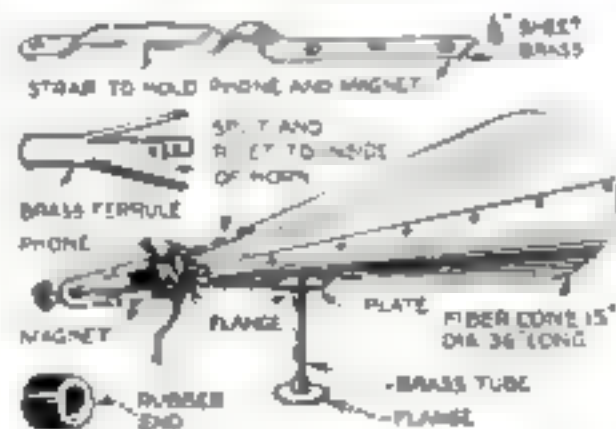
BY ADDING a powerful permanent magnet to an ordinary homemade loudspeaker, it can be made sufficiently sensitive to operate even with a crystal set, provided the receiver is quite close to a broadcasting station. The same loudspeaker, with a vacuum tube set or a combination crystal and vacuum tube receiver, gives exceptional results.

Most radio experts will be inclined to challenge the possibility of a crystal set's operating a loudspeaker. If you are interested, however, it will cost you little to make the experiment for yourself.

Music from the Arlington station at Radio, Va., five miles away, came in so well through a crystal set and the loudspeaker illustrated, that it could be heard from any position in a room about 9 ft. square. It was low but audible. Two local Washington, D. C., broadcasting stations, both nearer than the Arlington station, also were heard. A good quality commercial telephone with a metal diaphragm was used in the loudspeaker, and the set was of an ordinary variocoupler type.

The loudspeaker was also tested with a Baldwin mica diaphragm telephone, and the magnet added considerably to the

By George A. Luers
Mechanical Engineer



This unique loudspeaker is merely a permanent magnet, an ordinary radio telephone, and a fiber horn combined

strength of signals in both cases. In conjunction with the single tube set, using the same simple variocoupler, the music was clearly and distinctly audible in adjacent rooms, and provided music loud enough for dancing.

The horn of the loudspeaker is made of hard red fiber board. For satisfactory results, the material must be quite stiff

It is about 1 1/16 in. thick, 3 ft. long and 16 in. in diameter at the large end. The joint is fastened with paper fasteners or clinch rivets, preferably the latter. These also are used to fasten the horn to the bracket.

The bracket is a short length of brass tube with flanges at both ends. One flange is fastened to the baseboard or the table, and the other is attached to a thin brass or aluminum plate, which is bent to form a cradle for the horn and riveted to it. The fixture should be free to turn in any direction around its vertical axis.

At the small end of the horn is a brass ferrule or piece of tubing, split, drilled, and attached with rivets. Two brass clamps, bent as shown, are also fastened to the horn to hold the receiver in place. A piece of rubber tubing is drawn over the end of the ferrule so as to bear tightly against the telephone when it is in position.

At the rear of the telephone is located the magnet, which is gripped by the brass straps and placed so that the poles are against the back of the phone. The magnet can be one from an old magneto, or of the kind obtainable at any automobile supply store for use on auto flywheels.

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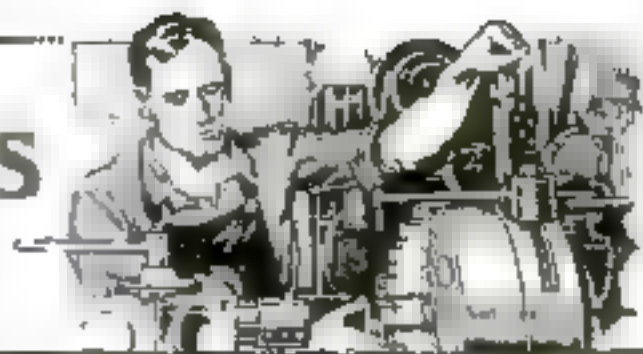
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Better Shop Methods

How Expert Mechanics Save Time and Labor



Improved Toolpost Speeds Up Lathe Work

By H. L. Wheeler
Machine Shop Foreman

THOROUGHLY tested for a long period by the writer, the lathe toolpost illustrated has demonstrated unmistakably that it has several advantages over the conventional type of toolpost found on the majority of lathes. It has stood up under heavy cuts very much better than the single screw type of toolpost. Even more important, the tool may be swung quickly to any angle and lifted or lowered at will with the precision of a micrometer and without altering the tool setting.

The tool has a better support than ordinarily and is held more rigidly because three binding screws are used. It also may be removed for grinding and replaced in practically the same position. None of the usual puttering around with hammer or wrench is necessary to set the tool back in position. There are no loose pieces when for any reason the toolpost is removed from the lathe; there is nothing to be lost or mislaid. Furthermore, the toolpost may be used for turning and boring either right- or left-hand with equal convenience.

In almost every machine shop one well known type of commercial boring bar is well liked, but these bars often cannot be used because the lathe toolposts either have too much or not enough side clearance for the space between the bar and holder. With this improved toolpost, however, there is no difficulty in using this type of bar and any size bar may be used.

An additional advantage is that the toolpost may be used

as a milling fixture for small jobs, and this feature should find great favor in small shops and garages.

The body (1) is made of iron, although steel may be used, if desired. It should be cast in rectangular form and planed to the

outside dimensions. The slope at the back should not be planed until the hole for the clamping bolt (5) and spacer (4) has been drilled, as it would be a rather difficult operation to machine this hole after the angle has been planed.

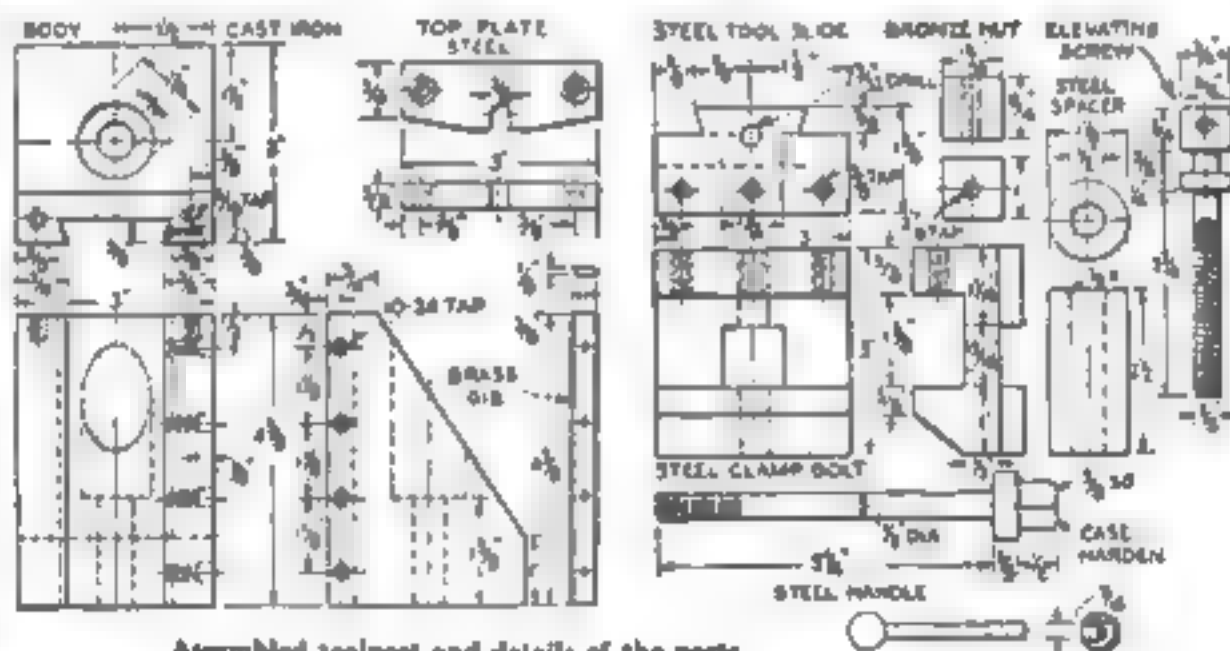
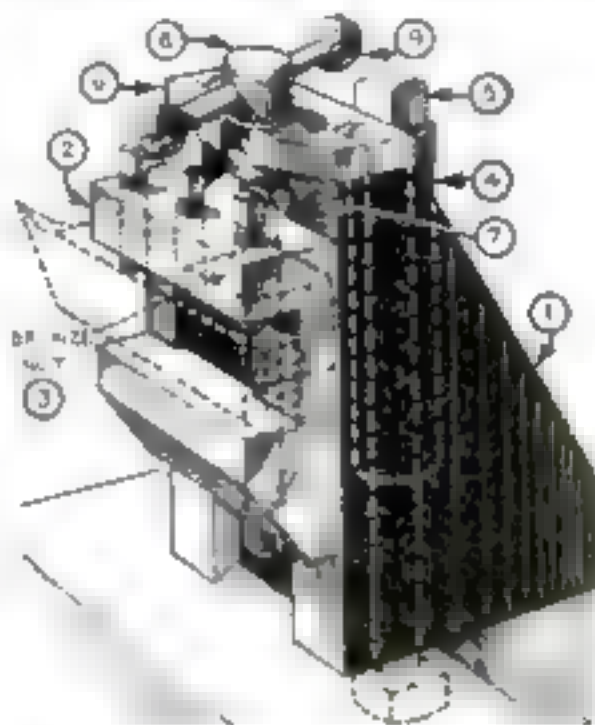
The tool slide (2) is made of mild machine steel and should be casehardened. This design shows tapped holes for three binding screws, although I believe two binding screws would be quite sufficient. The dovetail should be planed carefully and fitted to its corresponding seat in the body.

The nut (3) is made of bronze or brass and is merely a cube shaped piece nicely fitted in the square hole in the tool slide. The hole for the elevating screw (8) is located in the assembly after fitting by using a body size drill to spot the hole and then using the proper size tap drill. The hole drilled through the tool slide should be at least 1-32 in. larger than the screw, so that there will be no chance of the screws binding.

The design and dimensions of the top plate (6), the gib (7), and the handle (9) are made clear in the details. It should be noted, however, that in making the binding screw or clamp bolt a 5-82-in. fillet is used at the shoulder. I always put a fillet in places like that when possible because it gives additional strength where needed. The clamp bolt and the steel spacer should be casehardened.

The dimensions are, of course, suited only to one size lathe and necessarily will have to be changed to suit the lathe on which the tool holder is used.

The binding screws and all threads are standard.



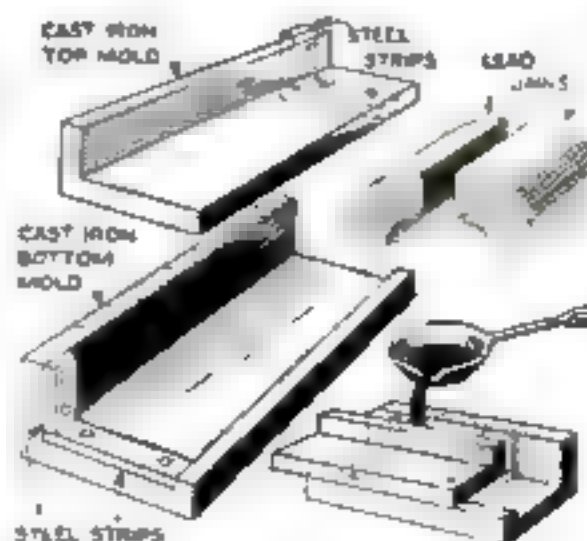
Assembled toolpost and details of the parts

Adjustable Mold Aids in Casting Vise Jaws

IN LARGE machine shops it is frequently necessary to cast lead vise jaws to fit vices of a number of different makes and sizes.

This work is greatly simplified by using the adjustable mold illustrated.

A convenient size for the bottom mold is 4 1/2 by 8 in. over all and for the top mold 3 1/4 by 8 in., the cast iron being 3/4 in. thick. A soft steel strip, 1/4 by 1 by 3 1/2 in., is fitted into the recess of the bottom mold, and a similar strip, 3/4 by 1 by 1 1/2 in., is riveted to the back. Corresponding strips are attached to the opposite end of the upper mold, and the edges are tapered 3 degrees where necessary for clearance. Smoke the mold before using, and make the jaws of lead, not babbit. Note the scale on back of bottom mold.—H. B. L.



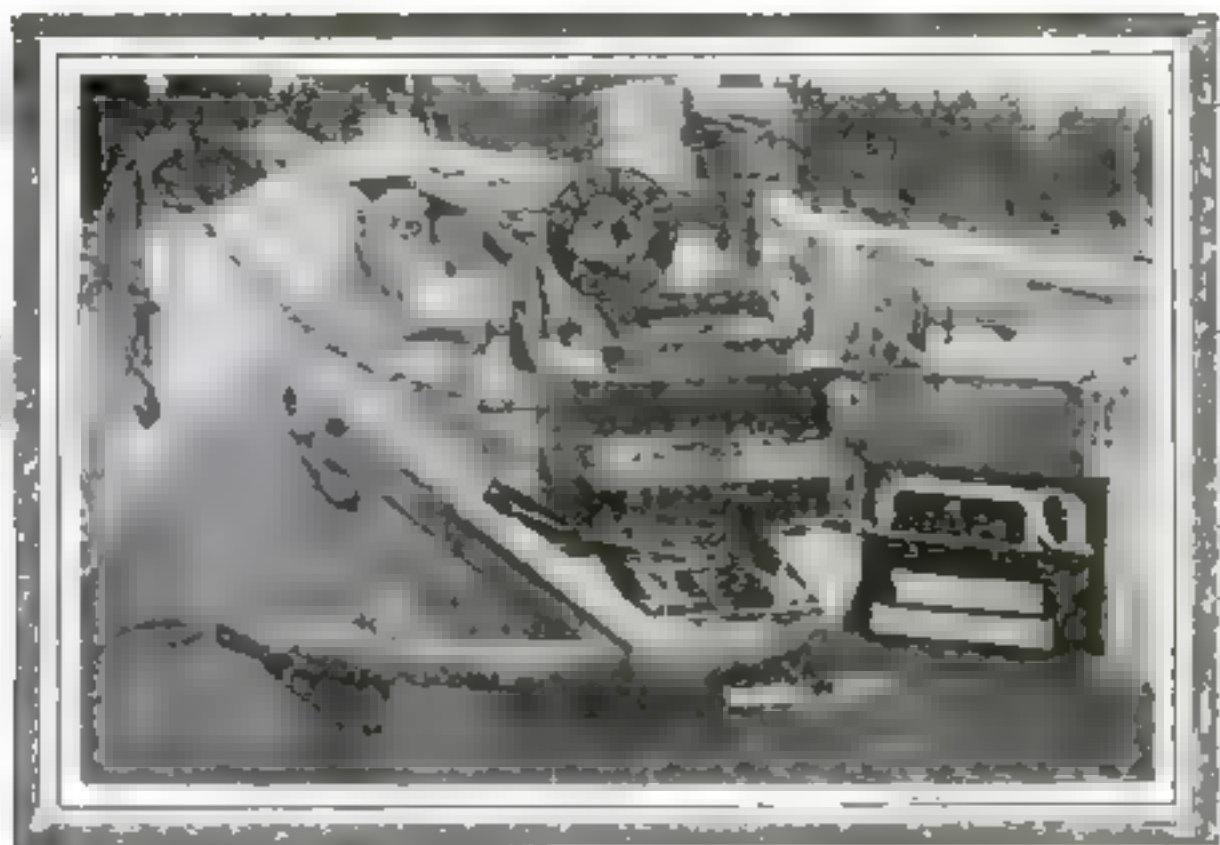
How the mold is made and used

"Close-Up" Knurling Tool

THE offset

construction of this knurling tool allows the knurl to work right up against the shoulder. This is an advantage when the work is such that the yoke-like arms of the common type of knurl holder are in the way. The steel shank is machined as shown and fitted with a retaining finger. The knurl pin is hardened tool steel and a driving fit in the tool shank. Case-hardening the shank will prevent wear.—J. R.





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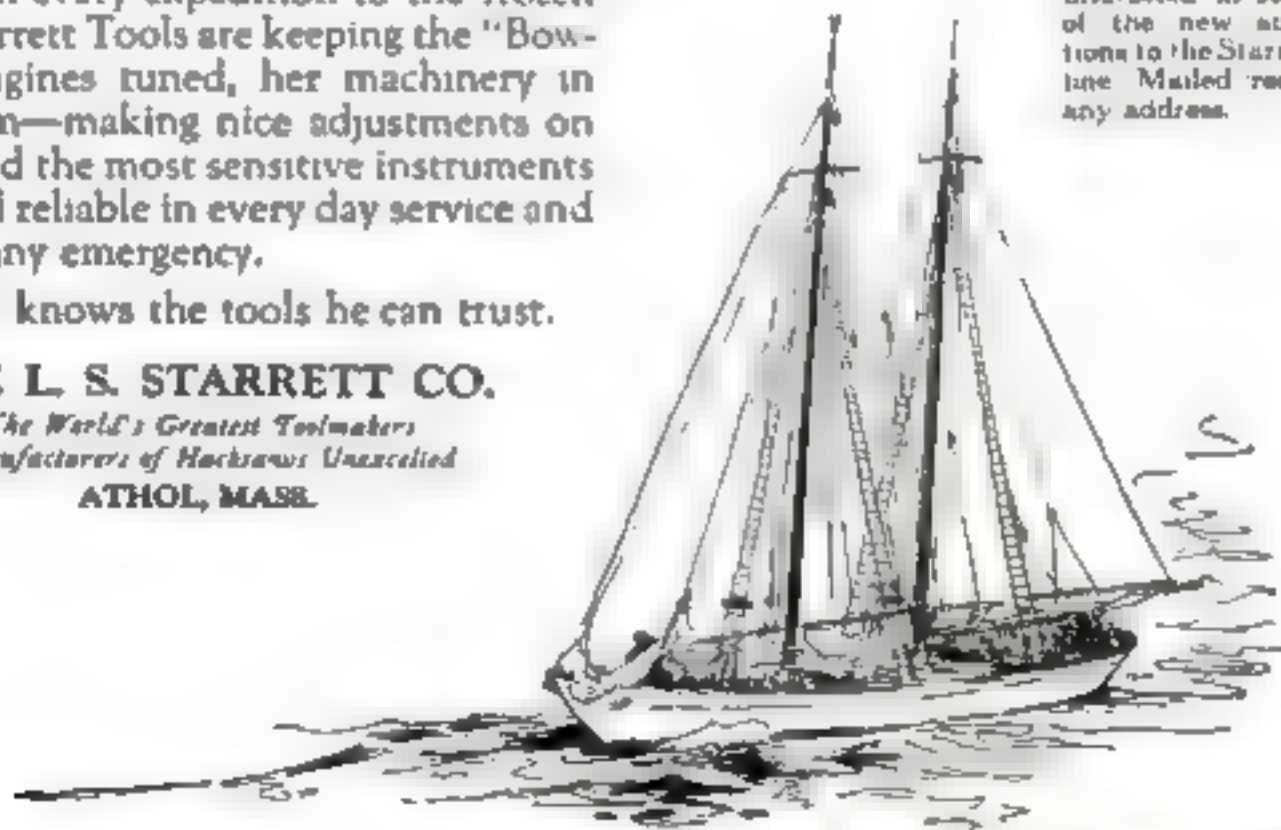
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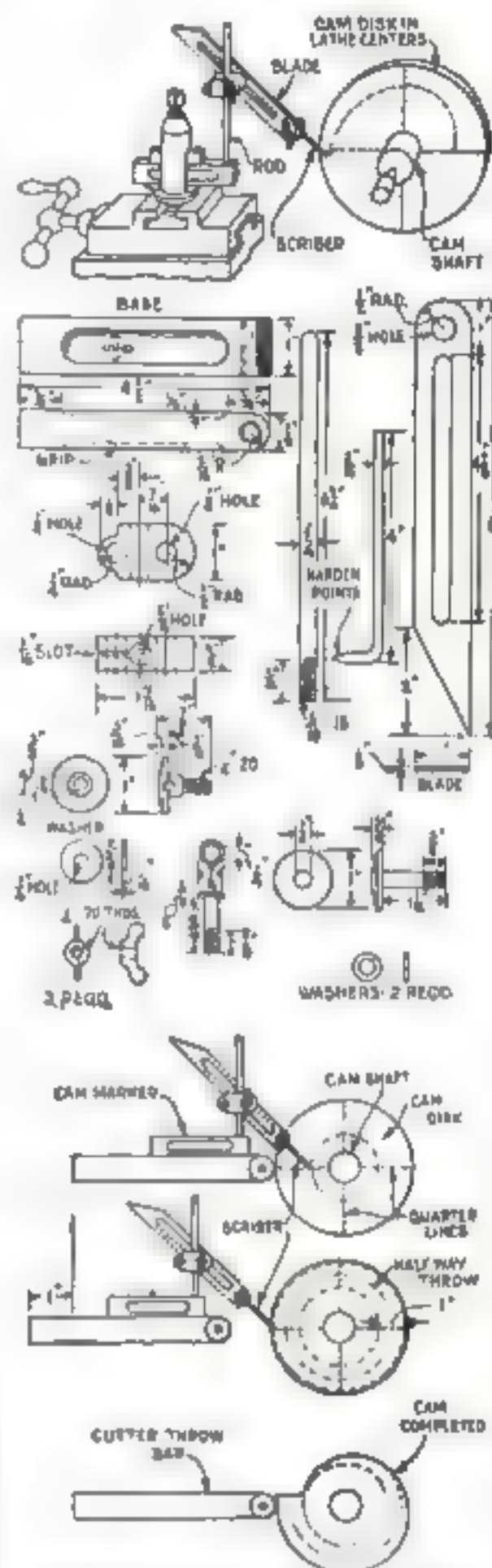
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Machinist's Marker Saves Time in Laying Out Cams

FOR the mechanic who has to lay out cams, the tool illustrated is a time saver. It was designed by Mr. William Hanson, a toolroom foreman, and is constantly proving its value in actual use.

The tool can be held in the toolpost of a lathe and the cam disk held between its centers, or it can be placed on the cutter



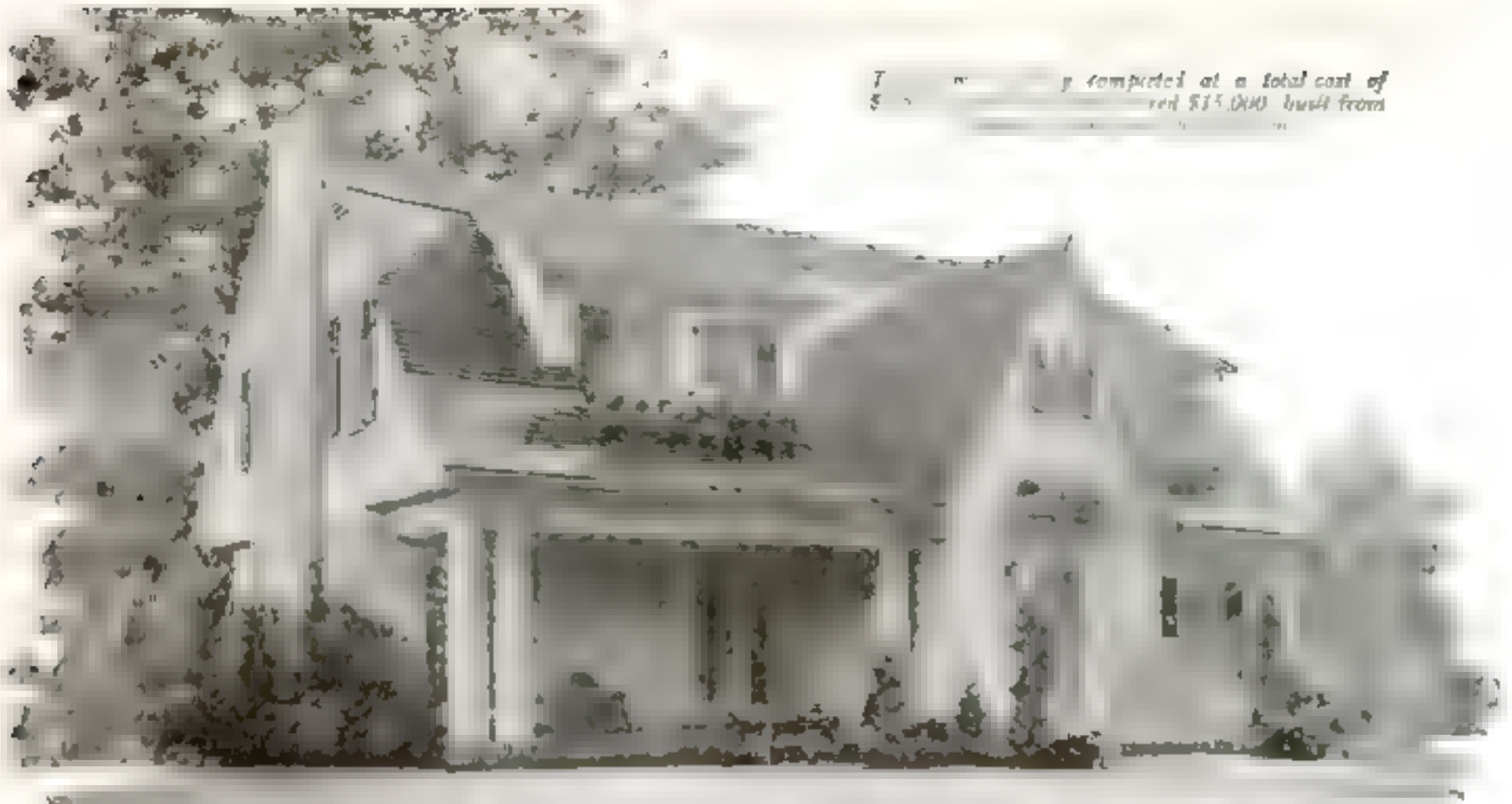
Details of the cam marker and how it is used

throw bar and the cam disk held in its place on the machine.

All parts are machine steel except the rod and scriber, which are drill rod. The base can be casehardened if desired.

The tool can be used as a surface gage, a holder for indicator, a height gage, and a bevel. It is top heavy for height gage work but a special wide base can be supplied or the rod may be screwed to a tapped hole in a short, wide parallel. H. L.

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Time-Tested Tricks in Casting Rabbitt Bearings

By Joe V. Romick

Machine Tool Designer and Builder

WHILE all machinists are more or less familiar with the use of Babbitt metal, there are, nevertheless, many tricks that make the work easier.

Babbitt metal is ordinarily a combination of three or more of the following metals, tin, lead, bismuth, antimony, and copper. Those mixtures with the largest content of tin usually cost the most.

If you wish to mix your own, place a ladle on a good fresh coal fire and throw into it the metal having the highest melting point. When this has melted, add the next highest, and so on until all are melted and fused together. Stir well with a wooden paddle or iron rod before pouring into the pig molds to cool. If copper is to be added to the mixture, it must be melted in a small separate crucible, and poured into the batch and stirred well just before removing the Babbitt metal from the fire. In order not to lose any of the high priced metals through oxidation, the metal



Goggles and a handy lump of clay will reduce the danger of accidental burns

should not be heated too much or be kept at a high heat too long. If, for any reason, a ladle must be kept going for the casting of many small pieces, the top surface of the molten metal should be protected by a sifting of finely pulverized charcoal dust. This will keep off the air and can be brushed or skimmed aside readily when pouring.

Before pouring a bearing, always stir the metal well. Invariably copper will rise to the top, and this valuable metal usually is lost when an inexperienced mechanic does the pouring. Use a wooden paddle or iron bar to run or dross the top dross beneath the surface, as that is the only way in which the copper can be saved. Rather than skim off the dross, push it to one side; when you have finished pouring, this same coating again will cover the surface and prevent a new coating from forming.

To make Babbitt metal pour freely, throw in a small amount of powdered rosin, and stir well, immediately before pouring. Rosin will also keep down the gas formation and should always be used when pouring into a moist or sweating bearing.

Excessive heat "kills" Babbitt metal and makes it harsh and brittle. A good test is to pour when the metal is hot enough to ignite a dry pine stick or aliver. This temperature is the best except when pouring into extensive, shallow cavities or deep and intricate recesses.

(Turn to page 90)



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Tricks in Babbitting

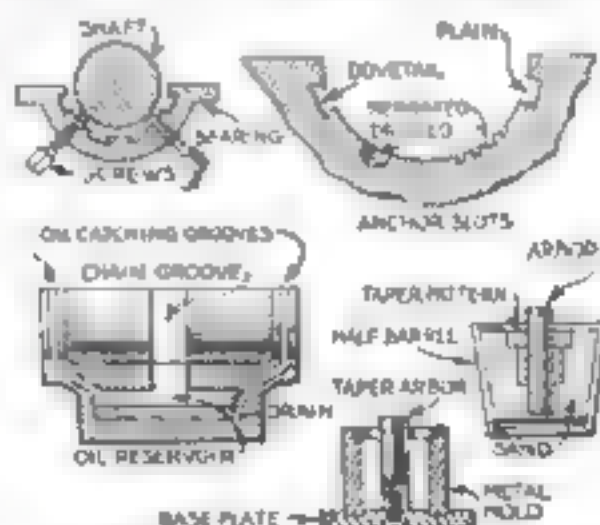
(Continued from page 88)

When possible, the bushing or bearing to be poured should be heated first so as not to chill the hot metal, as chilling has a tendency to crack the metal and causes abnormal shrinkage. Pour steadily and as fast as the gas formation will permit, and do not stop, as a stop will result in a lap or crack. When pouring large bearings that require several ladles, have them all hot and ready.

To make Babbitt metal hold in half circles and on flat surfaces, a system of grooves or slots is required as an anchorage. The surface of brass or bronze metal bushings sometimes is tinned with a half and half solder; this causes the poured Babbitt metal to unite perfectly. If a bearing is to be poured and no other provision has been made for anchorage, a drill is used to make shallow depressions, as shown. These shallow holes ordinarily should be only about $\frac{1}{4}$ in. deep and of the same or larger diameter, and should be spaced 1 in. apart. Grooves can also be chipped in the bearing pads with a cape chisel. Dovetailed grooves, slanting holes, or tapped holes must be used on flat surfaces.

Bearings are babbitted to size or, if smaller, bored to size. Rough work, where the accuracy of alignment and size is not important, is always babbitted to size. An old machine shop saying is that "the skin of the metal will be worth more if left unscraped than $\frac{1}{2}$ in. of the metal beneath," the logic being that the surface skin is the densest and toughest, and therefore will wear and last much longer than the metal below.

In order to withdraw an arbor and prevent it from sticking, every one uses either oil, smoke, or paper in some form. Oil really should not be used, as it gases too much and causes bubbles in the surface of



Aligning and supporting a shaft making anchor slots, a typical babbitted bar, and sand and metal molds

the poured metal. Heavy white lead, smeared on thinly and evenly, is perhaps the best for all around purposes. A single thickness of thin paper, either held with strings or with ends lapped and glued, will provide clearance for rough work.

Smoking the surface of the shaft with an oil torch will give a fine, dry surface, which does not gas at all, and the deposit of lamp-black permits the easy removal of the shaft. Painting the shaft with clay, mixed to a thin solution with water, is another method sometimes used.

Where accuracy is necessary, the bearing must be bored and reamed to size. Large bearings that are to be bored to size are usually peened. The hammering makes the

(Continued on page 91)



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Tricks in Babbitting

(Continued from page 90.)

surface metal denser and also closes up any laps or cracks. Peening is to be recommended wherever possible. On solid bearings that are to be bored, an arbor is sometimes run through the hole on a press.

Heavy cardboard and thin wood are used to close the open ends of a bearing, the pieces being cut to fit the shaft. These pieces must then be luted against the metal of the bearing. Clay of doughlike consistency forms the ideal luting material. Some use putty, but even when used in a thick or semihard condition, it will soften and run under the heat of the molten metal. Clay sets and hardens quickly and can be dried artificially with a blowtorch. Wooden dams are also used and must, indeed, be employed when the amount of metal is large and where the fall in level due to shrinkage is great.

On common chain or ring oiling bearings, the shaft can be supported on duck or hemp packing rings, the rings being cut to the proper width and placed in the oil drain grooves. When babbitting such a bearing, fill the oil reservoir and passages with fine sand, and top off all the exposed sand with a $\frac{1}{4}$ -in. layer of clay. Many a Babbitt "mine" has been poured by sticking cotton waste in a cavity and expecting it to hold back the hot metal.

When luting up the dams and crevices of a bearing, prior to pouring, it is a good stunt to place twisted strands of cotton waste in all of the crevices, so when the hot babbitt hits the waste, reinforced as it is by clay, it will stop, and by not coming in actual contact with the wet clay, will not generate any steam or gases. When pouring any bearing metal, always have a ball or two of clay lying handy for use in case of a broken dam or leak. The ball allows one to close a leak without the danger of burns.

When pouring a half bearing, level up both arbor and shell, and build a dam on each side at least $\frac{1}{4}$ in. higher than the flanged surface of the bearing. This will provide for the shrinkage and will leave no sunken edge.

Castings small in size can be made in wooden molds, preferably dry, soft white pine. Bushings, thrust rings, and the like also can be cast in the rough in either an iron mold or in sand. When casting Babbitt metal in sand, first wet the sand with kerosene and then add enough water to make it ball up in the hand.

Metal molds should always be bored with a generous draft, and arbors for solid work also should have a good taper. All arbors should be clamped in place to avoid floating.

Labor Saving Features to Appear Next Month

A SIMPLE fixture that takes the guess out of dressing grinding wheels to accurate radii will be described by Henry S. Leraby in the November Better Shop Methods Department.

Joe V. Romig will have one of his characteristic "Old Bill" stories on how a typical old-time machinist taught him to speed up his work. This will be followed in another issue by a remarkably helpful article on laying out work.

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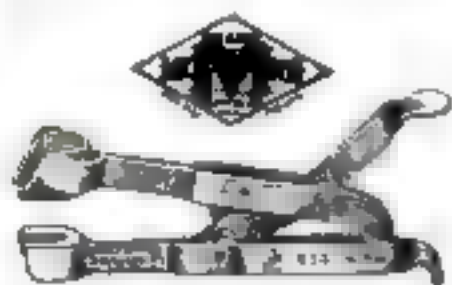
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No. 1944 "Double Four" Socket Set—2 Wrenches, 8 Openings

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Building a Kitchen Cabinet Work Table

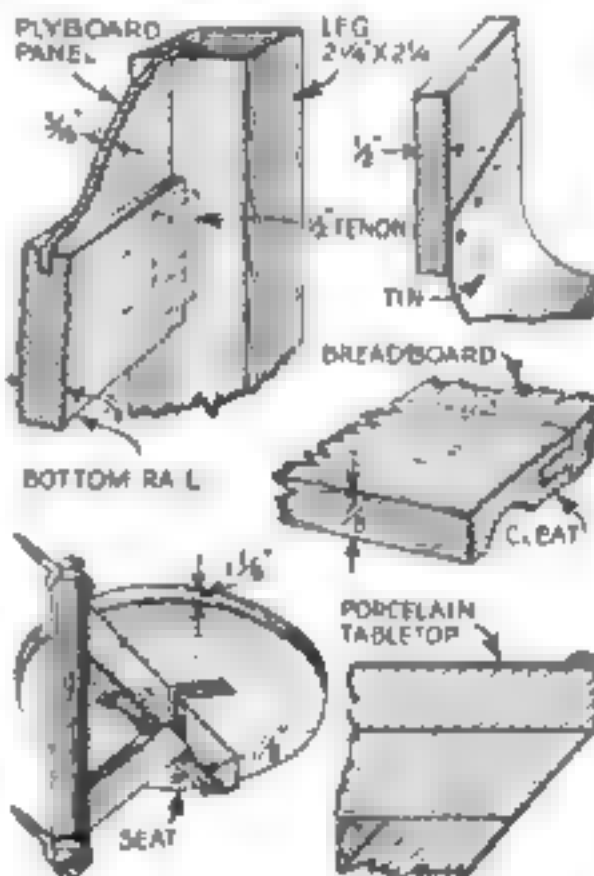
WHAT a workbench is to a shop, a kitchen table cabinet is to a kitchen. If properly designed and well made, it is a constant saver of the housewife's steps, time, and labor.

This kitchen work table—fully detailed in POPULAR SCIENCE MONTHLY's Blueprint No. 27—can be built at a moderate cost for materials by any home worker who is handy with woodworking tools, and will give service equal to, if not more satisfactory than the average expensive table cabinet sold in department or furniture stores.

All the available space beneath the table top is utilized. There are three breadboards, four drawers—one partitioned for knives, forks, and spoons—a large bin drawer, a cupboard with two sliding trays, and a seat. The top may be either wood or a wooden frame with a commercial porcelain top, as preferred. The essential dimensions and main details are made clear in the accompanying illustrations.

Several modifications may be made, if desired. For instance, if so much drawer space is not required, the bin drawer and the drawer immediately above it may be omitted. This gives more knee room and makes the table somewhat more comfortable if much work is to be done sitting down. If it is preferred to use a stool or chair in place of the swinging seat, the seat can be left off.

While the seat can be constructed easily, care must be taken to make the pivot from stock not less than $1\frac{1}{2}$ by $1\frac{1}{2}$ in. or $1\frac{1}{2}$ in. in diameter, the arm $1\frac{1}{2}$ by $1\frac{1}{2}$ in. and the brace $1\frac{1}{2}$ by $1\frac{1}{2}$ in. They must be of carefully se-



lected hard wood to insure the necessary strength. Even then, if a heavy person is to use the seat, it should be fitted with a supplementary foot made of a $\frac{3}{4}$ - or 1-in. dowel, and attached at the outside end of the cross arm. This leg should be fitted

with a caster so that it will also do over the floor easily when the seat is turned in and out. This takes much of the strain off the $2\frac{1}{2}$ -in. screweyes and the table leg.

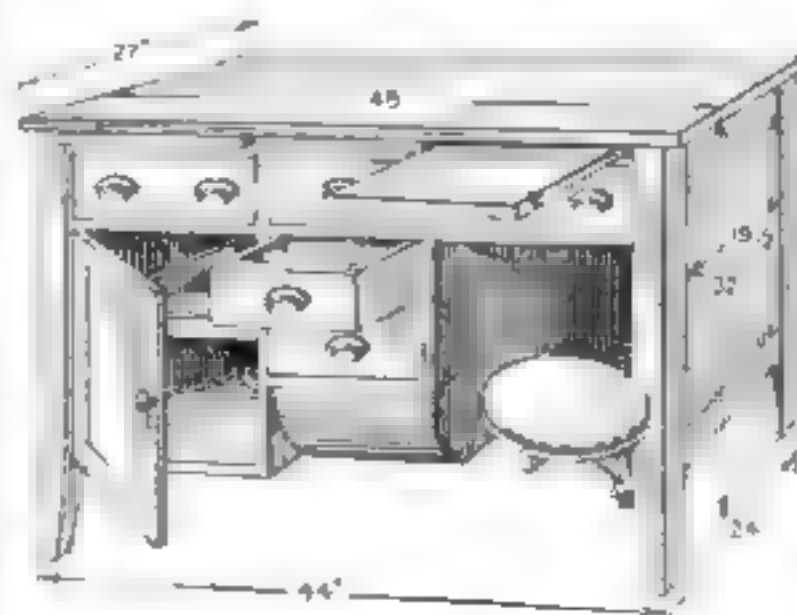
Ordinarily, the pivot would be simply a piece $1\frac{1}{2}$ by $1\frac{1}{2}$ by 13 in., well rounded on one edge and with round pins turned at each end, but a heavy curtain rod may be used, if available, or, if a lathe is at hand it may be turned throughout as shown and the other pieces fitted neatly to it.

Standard woodworking construction is followed throughout. The rails are tenoned into the legs, but may be doweled, if the maker prefer.

The legs are $2\frac{1}{4}$ by $2\frac{1}{4}$ by $31\frac{3}{4}$ in.; the four top and bottom end rails, $\frac{3}{4}$ by 4 by $20\frac{1}{2}$ in.; and the end panels, $\frac{3}{16}$ by $20\frac{1}{2}$ by $18\frac{1}{2}$ plywood.

If the cabinet is to be enameled white, which is usually the preferred finish, an excellent wood to use is whitewood, but any other soft wood that can be obtained easily and reasonably, such as white pine or cypress, will serve.

A complete bill of materials giving the exact sizes of the pieces needed in making the table, and full working details are contained in Home Workshop Blueprint No. 27, which will be sent to any reader for 25 cents.



The general construction and some of the more important details of the kitchen cabinet work table. Full working details are contained in POPULAR SCIENCE MONTHLY's Blueprint No. 27.

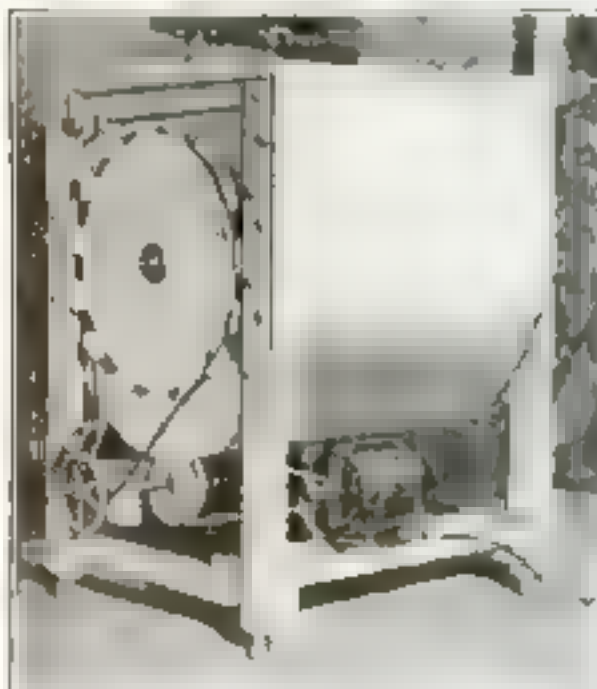
Are You Taking Advantage of Our Workshop Blueprints?

MANY of our readers are spending pleasant and profitable hours of their spare time in making articles described in the Home Workshop Department and detailed in our series of blueprints. A letter from one of them, Charles L. Hausel, of Marcus Hook, Pa., is as follows:

Inclosed find photograph of the electric washing machine I constructed from your Blueprint No. 12. The metal is copper screwed to the cyress. The bearings are pieces of iron pipe filled with Babbit metal.

I made the 6-in. pulley on the 1/2-inch diameter of 5-in. wood and the 3-in. pulley is one from a sewing machine, as I could not get any grooved pulleys. Every one is very well pleased with the results.

This is a typical letter, and articles by the thousand made from our Home Workshop Blueprints are being used everywhere.



For each photograph considered worthy of publication showing an article made from Home Workshop blueprints, like this washing machine built by Mr. Hausel, POPULAR SCIENCE MONTHLY will pay \$2. Send prints to the Home Workshop Department, Popular Science Monthly, 225 West 39th St., New York.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 26 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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How to Make Shaft Hangers

(Continued from page 24)

simpler if your bench is built against and fastened securely to a wall. A bushing in the side outlet allows the use of smaller pipe for the brace.

The same useful side outlet tee serve in another way to make the excellent overhead hanger shown in Fig. 3. As has been pointed out in this magazine before, overhead shafting should not be used in a basement shop, because it will vibrate the floor above, but in a regular shop, garage, or barn it has the advantage of not wasting any bench or wall space.

For the home workshop, lubrication can be supplied very easily by means of a small automobile grease cup screwed into a hole in the bottom of the bearing. Grease is not, of course, a satisfactory lubricant for a high speed shaft or for any shaft unless attended to at regular intervals.

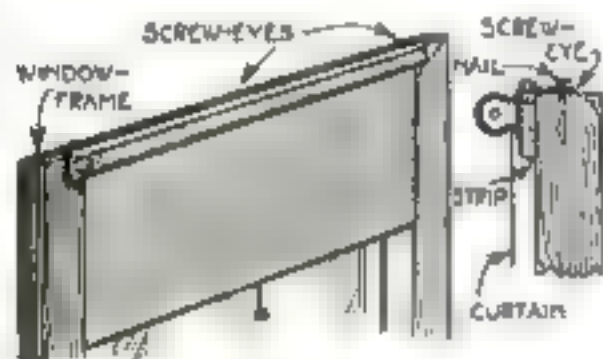
For mounting an overhead hanger on the usual 2-in. thick joist, oval pattern flanges are more satisfactory than the round type. This is another pipe fitting sometimes not to be had in a small store, but readily obtainable in large cities. It is well to ream the holes a trifle and use square head coach or lag screws instead of the slotted head screws for which the fitting is drilled and countersunk. For bench standards the common round flange is better, and through bolts and nuts are to be preferred to wood screws.

Attachment for Holding the Window-Shade Rollers

WINDOW shades may sometimes be used more satisfactorily if hung to the window-casings as shown below instead of in the usual fashion.

The shade and its brackets are mounted upon a light strip of wood or molding strip to match the style of window-casing.

Three screweyes are placed in the back of the roller support strip to hang it to



An auxiliary strip supports the roller brackets.

the top of the window-frame over three small screws or nails placed in proper position.

This allows rollers to be used on window-frames that may not be exactly suited to the length of the roller, or do not permit the brackets to be placed in the requisite positions. The woodwork is not damaged or marred by the brackets and the shades are easily removed for cleaning or changing.

When installing the screweyes and nails, be sure to make all uniform so that the strips may be interchangeable for all of the windows. B. F. DASHIELL.

Two varnishes of different kinds should never be mixed together because they will produce a new varnish that requires aging before use.



Miracle Men of Science

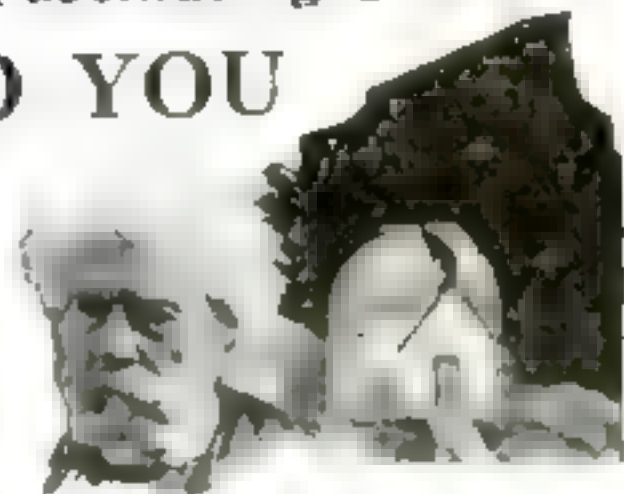
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Many Opportunities Like These
No Previous Experience Necessary

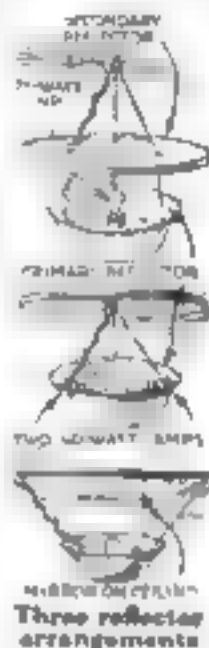
You can easily secure one of many fine hotel positions. An experienced employee, men and women, needed this year. A few weeks of your spare time will train you thoroughly if you enroll for the Hotel Operation and Management Course. We will help you secure a position in the next few months. In addition, a list of our graduates are available for you to see.

Send coupon today
Standard Business Training Institute
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BUFFALO, N. Y.

Cheaply Made Garage Lighting Fixture Banishes Shadows

BY USING two inexpensive homemade reflectors, you can light your garage or shop with a mellow, diffused light that is much better for working purposes than the harsh light thrown by a single reflector.

The primary reflector is simply a 10-cent pan or basin. In the center of the bottom, inside, is fastened a porcelain socket with small machine screws and nuts. The inside of the bowl is then painted with two coats of white enamel or with aluminum paint. The aluminum reflects well but diffuses more than the enamel.



The secondary reflector may be made of wood and should be at least twice the diameter of the bowl. This is covered with tin or painted like the bowl. At a point equidistant from its center and slightly less than the radius of the bowl from the center, bore three holes. These should be only a trifle larger than the diameter of the wire to be used in hanging the bowl, and should pass squarely through at right angles to the face of the reflector. Solder three pieces of picture wire to the bowl, as shown, and run the

wire through the holes in the secondary reflector, fastening them to strong screw-eyes. It will then be found that the secondary reflector may be moved up or down if the bowl is lifted a trifle to release the tension on the wire. It is, therefore, possible to adjust the secondary reflector at the point where it is most effective.

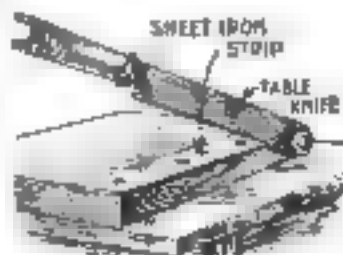
When the ceiling is too low to allow a secondary reflector, paint a circle with white enamel on the ceiling directly above the bowl. If the bowl is 16 in. in diameter, this circle should be about 4 ft. 6 in. An even better method is to mount an old mirror on the ceiling directly above the bowl, or suspend a mirror over the bowl, using four wires instead of three as in the case of the wooden secondary reflector.

The secondary reflector should be approximately 15 in. above the rim of the bowl, or the same distance above the bowl as the diameter of the bowl, in case a larger one is used. The best shape for a bowl is that of an ordinary hand basin.

When more light is needed than that given by a 75-watt nitrogen bulb, use two regular 60-watt lamps.—M. E.

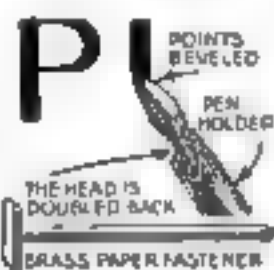
Table Knife Quickly Converted into Photo Trimmer

A WASHINGTON, D. C., schoolboy who wished to trim a number of small photographic prints, improvised the paper trimmer illustrated. The blade is a cheap steel table knife, one edge being ground to a sharp bevel. The knife is attached to a block of wood with a round head screw and washer and a strip of sheet iron is fastened to the right-hand edge of the base. The surface can be laid off with guide lines for measuring.—G. L.



Brass Paper Fastener Serves as Heavy Lettering Pen

A DRAFTSMAN who does high-grade shaded lettering on certificates, testimonials, and showcards, rarely uses anything but pens made of brass paper fasteners for heavy lettering.



For "black letter" alphabets

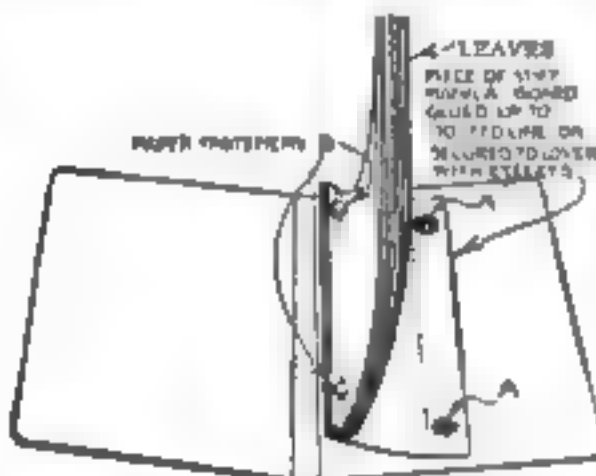
The amateur draftsman will find this type of pen a useful makeshift when a commercial shading pen is not at hand.

A fastener should be chosen of a width corresponding to the width of the stems of the letters. The head

is then doubled back to fit a penholder, from the center of which the split plug has been removed. The points are shortened, beveled back from the outside, and bent to form a reservoir for the ink. The edges are then filed to make them even.—C. M. T.

Speedy Method of Making a Loose-Leaf Notebook Cover

WHEN a loose-leaf notebook cover is needed quickly, or one of an odd size or shape is required, you can make it for a fraction of the cost of a commercial cover. The one illustrated, for a 4½ by 7½ in. sheet, is made of thin fiber board 7½ by



An extra fiber strip inside the back cover holds the leaves

8½ in. Another fiber piece 2 by 6½ in. is fastened with small metal eyelets, A, or paper fasteners to the cover, as shown. The loose leaves are then fastened to this strip with two or three paper fasteners, B.—A. E. STURDIVANT, Muncie, Ind.

When Grinding Wood Chisels

TO GRIND chisel and plane bits quickly and accurately I use a guide as shown. By holding the forefinger against the guide as a stop and running the tool to and fro sideways, never changing the grip when dipping the steel in water or examining the edge, I am sure to keep a true bevel.

A good many carpenters and cabinet makers, even after considerable experience, grind their tools "freehand" and therefore get several varieties of bevel before they obtain a good edge. An 8-in. length of ½-in. steel rod fixed about 1 in. above the arbor of the grinder makes a convenient guide.

—WALTER LYON, Plymouth, Wis.



The grip remains unchanged throughout



Learn to Play

You are always popular and sure of a good time if you can play some musical instrument. By yourself, with your friends around the piano, in orchestras or bands, there is no end to the pleasure music will give you. And there is no easier way to earn money in your spare time.

Try It in Your Own Home

You may now have any known musical instrument for a week's free trial in your own home. There is no obligation to buy—no expense for the trial. You may return the instrument at the end of a week if you decide not to keep it.

Wurlitzer instruments are known everywhere for their unusual tone quality and excellence of workmanship. They are used by the greatest professional musicians, bands and orchestras. Harry L. Jacobs of Sousa's Band, Brooke's Marine Band, and Chicago Grand Opera says: "I am proud to be the owner of one of your new cornets. It is positively superior to anything I have had in all my years of cornet playing."

Thousands of amateur musicians are playing on Wurlitzer instruments. Many of them could not have bought except through the Wurlitzer selling plan.

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The Wurlitzer plan makes it easy for you to own the instrument you want. Payments are conveniently arranged in small monthly sums—a few cents a day will pay.

Wurlitzer is the world's greatest music house, with stores and dealers in all parts of the country. But no matter where you live you will receive the same service by mail as though your lived next door to the factory. Send the coupon today.

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The greatest musical catalog ever published. Over 2,000 articles—every known instrument described and illustrated—many of them shown in full color. Gives you all details of the Wurlitzer plan. Send coupon now.

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Send me absolutely free your new illustrated catalog of musical instruments. Also tell me how I may try any instrument in my own home at your expense and how the Wurlitzer plan makes it easy for me to buy. No obligation.

Name.....

Address.....

City.....

Instrument.....
(Circle instrument in which you are interested.)



"What panel shall I use?"

ONE of the first questions you probably will ask yourself when you get ready to build your radio set will be about the choice of a good panel. Your answer will determine, to a large extent, the efficiency of your set.

Of course you want a panel that has superior insulating properties. Celoron Radio Panels are used by fans who appreciate the value of a good radio panel. They have high dielectric strength and great volume and surface resistivity. Celoron panels are uniform in quality, and do not warp or crack.

You will find Celoron panels easy to saw, drill and tap. They engrave evenly without feathering, and enable you to build a set that is neat and attractive as well as efficient.

Approved by Uncle Sam

Celoron Radio Panels are approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps. Many of the leading manufacturers of radio equipment use Celoron in their standard parts.

Each panel is wrapped separately in glassine paper and carries complete instructions for working and finishing. Ask your dealer for one of the following sizes:

| | |
|--------------------------|---------------------------|
| 1—6 x 7 x $\frac{1}{8}$ | 5—7 x 18 x $\frac{1}{8}$ |
| 2—7 x 9 x $\frac{1}{8}$ | 6—7 x 21 x $\frac{1}{8}$ |
| 3—7 x 12 x $\frac{1}{8}$ | 7—7 x 24 x $\frac{1}{8}$ |
| 4—7 x 18 x $\frac{1}{8}$ | 8—12 x 18 x $\frac{1}{8}$ |

We also furnish Celoron in full-sized sheets and can cut special sizes if desired. If your dealer has not yet stocked Celoron panels, ask him to order for you, or write direct to us. Indicate by number the size you want.

Send for free booklet

Our booklet, "Tuning in on a New World," contains a list of the leading broadcasting stations in the United States and Canada, several efficient radio hook-ups, and an explanation of the symbols used in radio diagrams. Write at once and be sure of getting yours before the supply is exhausted.

To radio dealers: Send for special dealer price list showing standard appointments.

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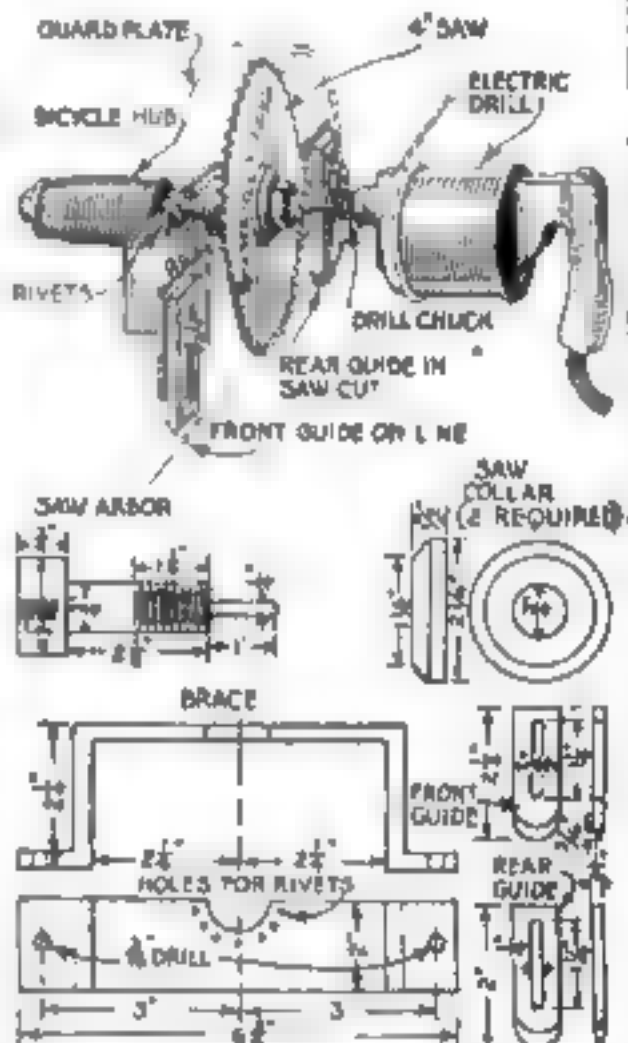
CONDENSITE
CELORON
STANDARD RADIO PANEL

Making a Grooving Attachment for an Electric Drill

By Arthur M. Samp

IF YOU are a worshiper at the home workshop shrine, you will do well to add an electric hand drill to your set of tools. One can be made, should the expense of a commercial drill not be warranted. Then, having a drill, add the saw attachment for grooving that is illustrated below. It will greatly increase the pleasure of woodworking, especially furniture and cabinetmaking.

The saw arbor is turned from a piece of cold rolled steel about $1\frac{1}{4}$ in. in diameter and 4 in. long. It is threaded with a left-hand thread and drilled and tapped to take the spindle of an ordinary bicycle hub. Two collars to hold the saw



Complete groover and details of the saw arbor, collars, brace, and guides

in place are purchased or made of mild steel.

A brace—of $\frac{1}{4}$ by 1 in. strap iron—for holding the guides is bent up and fastened to the face of the hub with small rivets. The front and rear guides are made of $\frac{1}{4}$ by $\frac{1}{4}$ in. strap iron and slotted with $\frac{1}{4}$ -in. slots. They are fastened to the brace by means of $\frac{3}{16}$ by $\frac{1}{2}$ in. stove bolts. The bicycle hub is wound with tape to form a suitable handle.

The guard is put on for safety, and it also serves to keep the sawdust from being thrown into the face of the operator. It is simply a piece of heavy sheet iron fastened to the brace.

The 4-in. cut-off saw can be purchased from any large hardware or woodworking machinery supply store, or even from one of the larger mail order houses.

To use the device for grooving, the small end of the arbor is placed in the drill chuck and the operator holds the drill in his right hand and the hub with his left. By means of the guides, the saw is made to follow the line. A scale of notches may be placed on the guides to make it possible to cut to a desired depth at the first attempt.

\$25.00 in PRIZES See top of page 4 in front of book for full details.

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10½ inches
long—
yet has
five
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Weighs only 20 ounces. Slips into pocket. Yet has all five adjustments of big "Yankee" Drills. Finger-touch gives you: Plain Drill, Left-hand Ratchet, Right-hand Ratchet, DOUBLE Ratchet, or Gears Locked.

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Pictures and describes all the ingenious "YANKEE" Tools. Spiral Screw drivers, Ratchet Hand Drills, Automatic Push Drills, and many others. Write for your copy today.

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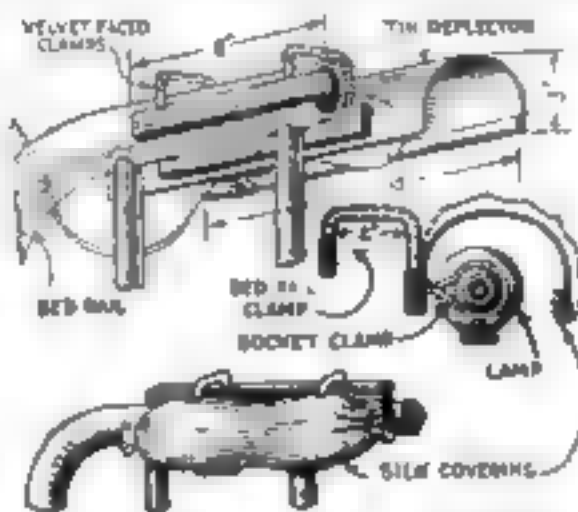
"YANKEE" TOOLS

Make Better Mechanics

Can Serves as a Reflector for Ornamental Bed Lamp

NEAT and inexpensive to make, the reading lamp illustrated is designed to hook on to the head of a bedstead. Its reflector is nothing more than a can about 6 in. in diameter and 10 in. long, cut lengthwise so that it will form a semi-circular roll about 3 in. deep.

Make two wooden cleats $\frac{1}{2}$ by $1\frac{1}{4}$ by 8 in. and drill 2 holes edgewise through each to take a length of $\frac{1}{4}$ -in. steel wire. The wire, which should be in one piece about 22 in. long and covered with snug



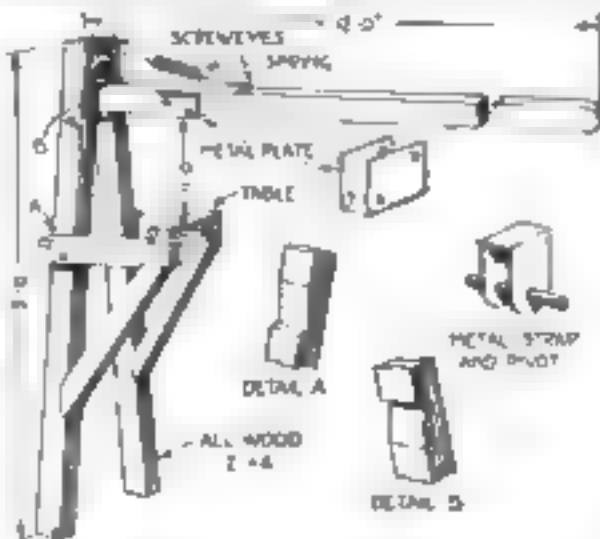
Storage of tin, wire, wood, and silk form the parts of this curiously light

fitting rubber tubing, is bent into a U and slipped through the holes in the cleats. The ends of the wire are clinched to prevent the rear cleat from dropping off.

Next, bend the wire to form a clamp over the head of the bed, as shown. Cover the cleats with velvet to protect the finish of the bed. Fasten the reflector to the front cleat with screws and inside attach a wire loop $1\frac{1}{4}$ in. in diameter to hold the lamp socket. Solder ends to the reflector, and make a hole for the lamp-cord to pass through, being careful to roll the edge to prevent chafing the insulation. Cover the reflector with ruffled silk, fasten a socket in the wire loop, make the connection, and the light is ready for use.—EDWIN M. LOVE, Alhambra, Calif.

Light Press Built Cheaply from Two by Fours

BUILT mainly of 2 by 4 in. lumber, this cheap homemade press serves for putting in or removing bushings and gears, straightening parts, and performing similar



The 12-ft. lever gives power enough for all press operations usually encountered in the home workshop

work that requires considerable pressure. By the use of suitable blocks, short pieces of pipe, and mandrels, almost any simple presswork can be done with this press.—L. G.

Points a Finger at Any Shortcomings

Point at a workman's production-record, or a machine's rate-of-work:—you will make your point! The record will be improved if it *should* be.

Your presence at the machine isn't demanded. A Veeder Counter will represent you, and get the results *due* you.

In developing production (human or mechanical), what's required of the man and possible for the machine may be had with a

Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as press and metal-stamping machines, where a reciprocating movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50—subject to discount. (Cut less than $\frac{1}{2}$ size.) Set-Back Revolution Counter of similar model, \$10.00 (large).

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording

the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to any kind of counting purpose, by regulating the throw of the lever. Price, \$2.00. (Cut nearly full size.) Small Revolution Counter, also \$2.00.

Everything you could ask in a counting device is shown in the 80-page Veeder booklet. Ask for this wonderfully complete counter book—free.

Everything you could ask in a counting device is shown in the 80-page Veeder booklet. Ask for this wonderfully complete counter book—free.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.



Boys!

These are perfect working models

THINK of the fun of operating a complete Railroad System, all your own! One that is an actual reproduction, down to the slightest detail, of the most up-to-date railroads in the country.

Ives Railroads are perfect working models. There are powerful electric passenger engines, exact reproductions of the latest type used by the New York Central; husky freight locomotives like those on the big coast-to-coast lines. These engines reverse and have real headlights and you can control their speed accurately.

There are parlor-cars, coaches and observation cars with real lights inside them and automatic couplings. There are mail and baggage cars, box-cars, tank-cars, cattle-cars, gravel-cars. There are switches, semaphore signals, station-lights, crossing gates, etc. Everything, in fact, that there is in a big system. You don't know what fun is until you operate your own Ives Railroad.

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There is a beautifully illustrated book with 12 pages in full color that tells all about Ives Trains and Ives Boats. It shows you just why every boy wants the real thing, made by Ives.

Send 10¢ in coin or stamps with your name and address and you'll only have to wait a few days before the post-man brings you your copy of this great book.

THE IVES MANUFACTURING CORPORATION

203 Holland Ave., Bridgeport, Conn.



Ives Toys
MAKE HAPPY BOYS

Constructing a Sawtable

(Continued from page 102)

plates have been put in place. It should be noted that one right-hand plate and one left-hand plate No. 6, and one right- and left-hand plate No. 7 are required. By tilting the table, the depth of the saw cut is regulated.

The framework may be painted, shellacked, oiled, or varnished, except the table top, which is simply oiled. It is advisable to paint the inside of the top to exclude dampness as much as possible.

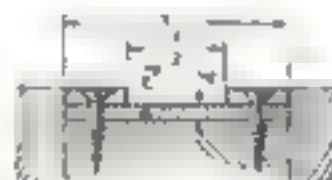
The detachable ripping fence permits making cuts at angles up to 45 degrees. Cross cut angles are obtained by adjusting the cross cut fence, and to facilitate angular work a scale of degrees may be laid out on the cross cut fence sector.

The list of materials for the sawtable is as follows.

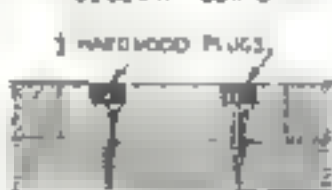
Table top, 2 by 35 by 43 in., maple or birch.

Top chords, 2 by 4 by 10 in., oak, 2 required.

Turn to page 104

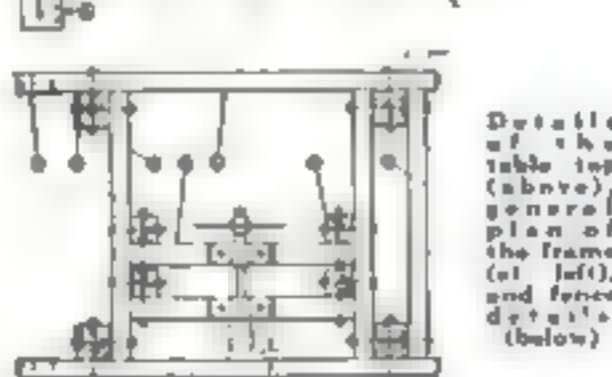
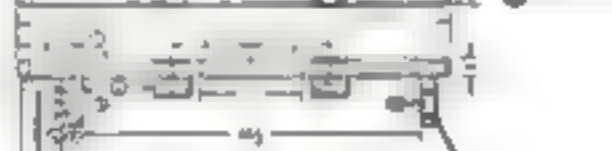
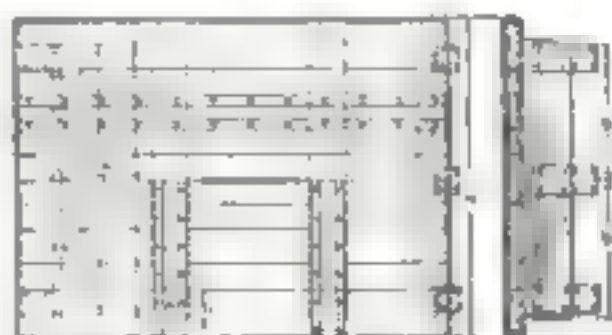


SIDE VIEW DETAIL

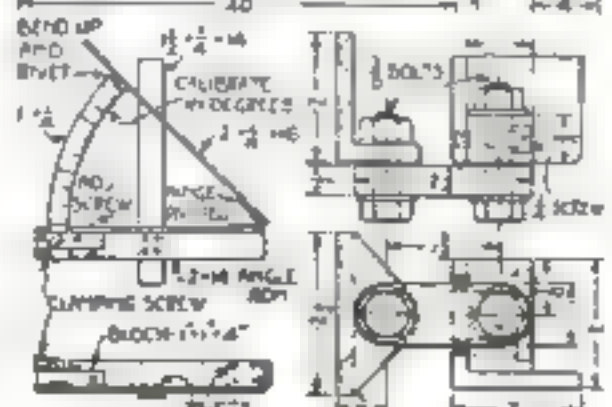
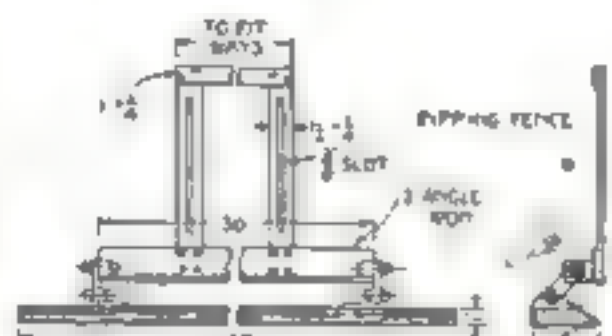


HARDWOOD PLUGS

METHOD OF FASTENING TABLE TOP



Detail of the table top (above), general plan of the frame (at left), and fence details (below)



CROSS CUT FENCE

RIPPING FENCE DETAIL

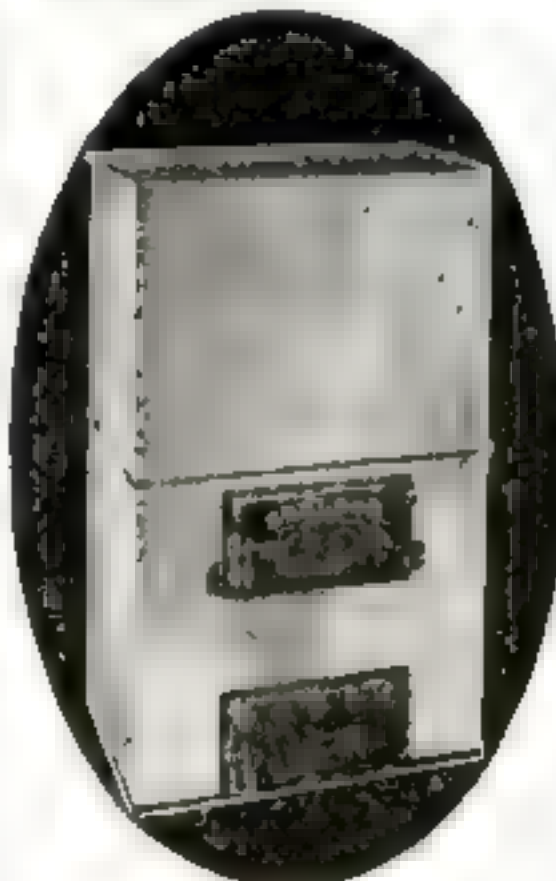
2½ Tons Heats 5 Rooms!

"There is no heater to compare with the Bulldog. I burned 2½ tons of coal last winter and heated five rooms and bath."

—Walter Gentry, Gloucester, Mass.

That's what the Bulldog does with coal! Here's what it does with about the lowest grade fuel you can think of!

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\$10

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If you are even thinking of a pipeless furnace, or any furnace, write for our free catalog. The Bulldog is one furnace you MUST investigate. Comes completely erected. You install it yourself! A really extraordinary development in heating. Factory connections in both East and West. We ship from nearest point. Don't consider buying any furnace until you find out about the Bulldog. Write now before you forget!

Fits Any Floor Height

No matter what the depth of your basement or cellar may be the Bulldog fits it. The adjustable casing (another common sense feature) takes care of this.

Write at once for our offer and our free catalog together with the wonderful record of Bulldog success. Mail this coupon today.

Write to Babson Bros., 1244 and California Ave., Dept. 12-67 Chicago

Without obligating me in any way please send me your free catalog and \$10 down offer on the Bulldog Pipeless Furnace.

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Address



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Nothing speaks so eloquently of HOMCHARGER satisfaction as the fact that thru sheer merit alone it has become the standard by which all other battery chargers are judged. Over 125,000 HOMCHARGERS already in use offer the most convincing proof that it is the most efficient, economical and fool-proof battery charger at any price.

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4. **Clean**—No expensive bulbs to break or acids to spill or replace. No acid fumes. Charges without noise, fuss or bother.
5. **Dependable**—Tungsten contacts insure continuous operation—prevents sticking and arcing.
6. **Fool-Proof**—Can be operated by anyone. Attach to lamp socket and current halcyon either way it will always charge. High-grade gemmeter eliminates guess work.
7. **Safe**—No danger of shock or fire. Tested and approved by Fire Insurance Underwriters everywhere. Gives tapering charge with no overheat or injury battery.
8. **Beautiful**—Mahogany and Gold Finish.
9. **Unqualifiedly Guaranteed**.
10. **Popularly Priced**—Retail at \$19.95 complete (\$17.95 Canada). No extras to buy. Sold by all dealers.

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It is your protection against substitution. When buying order by name and verify by the GOLD SEAL, which appears on the carton as well as the nameplate.



THE AUTOMATIC ELECTRICAL DEVICES CO., 131 West Third St., Cincinnati, O.
Largest Manufacturers of Vibrating Rectifiers in the World

\$25.00 in PRIZES

See top of page 4 in front of book for details

treat bruises
and possible breaks of the skin with the antiseptic liniment. Removes pain and reduces swellings. Kills germs and prevents infection. Only a few drops required. Safest for children. \$1.25 as drug store or postpaid. Liberal trial bottle, postpaid, 50c.

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Absorbine-J
THE ANTISEPTIC LINIMENT

MURACO
GETS EM 1500 MILES AWAY

At the low prices shown below you get the efficiency of a car running three times as much. These radios frequently received over 1500 miles away under ideal conditions.

Operate either on DRY CELLS or storage battery of 6000 mah capacity and must throughout (under direct or moon for Two Tube outfit, as shown above. Headphones.

Four tube outfit for loudspeaker or headphones \$12.50.

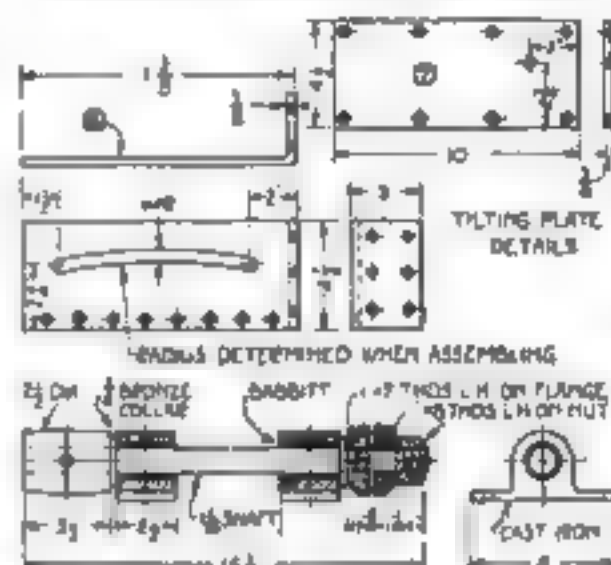
DEALERS—write for proposition quickly—it's a money saver.

THE MIDWEST RADIO COMPANY
904 Main Street Cincinnati, Ohio

Constructing a Sawtable

(Continued from page 103)

Top cleat 2 by 3 by 28 1/4 in. oak.
Top cleat 1 by 5 by 50 in. oak.
Place brace 1 by 11 by 26 1/2 in. oak.
Tilting plates 1/2 by 4 1/2 by 14 1/2 in. iron, 2 required.
Tilting plates 1/2 by 4 1/2 by 10 in. iron, 2 required.
Legs 4 by 4 by 36 in. oak 4 required.
Cross rails 1 by 10 by 30 in. oak 2 required.
Bearing beams 1 by 7 1/2 by 24 in. oak 2 required.
Tackle aprons 1 by 10 by 40 in. oak 2 required.
Tie pieces 1 by 5 by 7 1/2 in. oak 4 required.
Ringer cross rail 1 by 5 by 30 in. oak.
Motor shelf 2 by 12 by 36 1/2 in. oak.
Lower tie pieces 1 by 4 by 36 1/2 in. oak 2 required.
Lower cross rails 2 by 4 by 30 in. oak 2 required.



Details of the tilting plate and the arbor. The latter is standard and can be purchased cheaply.

Heavy hinges 3 by 4 in. steel, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 4 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.
Screws for slides, 1/2 by 1 1/2 by 17 in. iron, 1 required.

Fence Materials

Angle iron 2 by 2 by 14 in.
4 lb. iron 2 by 2 by 10 in.
Rail 1/2 by 1 by 10 in. iron.
Screws 1/2 by 1 by 14 in. iron.
Screws 1/2 by 1 by 14 in. iron.
Screws 1/2 by 1 by 14 in. iron.
Screws 1/2 by 1 by 14 in. iron.
Screws 1/2 by 1 by 14 in. iron.
Screws 1/2 by 1 by 14 in. iron.
Screws 1/2 by 1 by 14 in. iron.

A motor of 2 hp. is required for average work. If heavy cutting of hard woods is to be done, it would be better to use 3 hp. The switch should be placed in a position where it can be reached handily. It is well to have a locked or padlocked switchbox to prevent the saw's being operated by any one not skilled in its use, as the machine, like most woodworking machines, is dangerous unless properly handled. The utmost caution should be used at all times in operating it, as with a standard sawtable.

A countershaft can be used in place of the motor if the saw is to be driven by a belt from a gas engine, an auto wheel, a tractor, or other source of power. The pulleys should give a speed of at least 900 r.p.m., although theoretically the rim speed of a circular saw should be about 9000 ft. a minute, which means in the neighborhood of 2600 r.p.m. for a 10-in. saw. In other words, the high speeds are better if the power is sufficient.

Electric Iron Alarm

RECENTLY we found the house full of smoke caused by a red-hot electric iron that had been left on the ironing board. To prevent a similar accident, I placed a two-way socket at the end of the drop and screwed the iron plug in one and a red light in the other. The light reminds one to switch off the current.—G. M. V. H.

Still Time to Enter "The Most Useful of My Tools" Contest

IF YOU are reading this issue of POPULAR SCIENCE MONTHLY before September 20—it goes on the newsstands September 10—you still have time to enter the current tool contest and perhaps win one of the three prizes.

All mechanics and home workers do not agree on which is the most useful of their tools. Some prize most highly the saw, others the hammer, others the ax, the plane, the chisel, the file, the screwdriver, and so on. Mr. Romig put up an excellent argument last month for the steel tape line.

Now then—which is the most useful of your tools? Which one do you use most? Why? And how? Undoubtedly you have some uses for your tools that nobody else has thought of. Tell us about it in a letter of not more than 400 words.

We offer these prizes: \$25, first prize; \$15, second prize; \$5, third prize. The competition closes September 20. The winning letters will appear in the January issue.

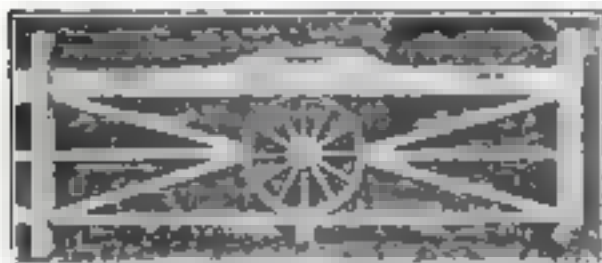
Each letter will be judged by the Board of Editors and their decision will be final. No letters will be returned unless accompanied by a self-addressed, stamped envelope.

Address, Tool Contest Editor,
POPULAR SCIENCE MONTHLY,
225 West 39th St., New York.

Auto Wheels Form Decorations for Fence Panels

AN UNUSUAL design for a fence can be obtained by using discarded auto wheels as decorations. Such a fence is especially appropriate around a filling station or on the grounds about a garage.

The construction is simple yet rigid. The top and bottom rails of each panel are



An ornamental fence for garages, and for general fencing purposes

2 by 2 in. and the wheel is held between them by the flanges of the iron rim. The fillers and braces are also 2 by 2 in. but the posts are 4 by 4 in. Good proportions are obtained by setting the posts 8 ft. apart. A 1-in. board cut in some simple pattern finishes off each panel neatly.

Paint the wheel some darker color such as green and the rest of the fence white.—
C. L. MILLER, South Fargo, N. D.

WHY NOT YOU?



Garage foreman at \$75⁰⁰ a week —and in line for further promotion

Positions like this are waiting for men who can fill them. **AND BEER J. J. J. AHEAD.** Above the foreman. There is a better job as Service Manager. Every automobile dealer, every service station in every city in the country needs one or more high grade foremen or superintendents. Where can we get trained men? They ask desperately. They will willingly pay big money to you if you can fill one of these jobs. They want men who are not only good auto mechanics, but who know shop management,

modern repair methods, electric service and who have a thorough understanding of the business as a whole. You can get that knowledge in three months at the Michigan State Automobile School in Detroit, the Auto Center. Men in low paid uninteresting trades, can fit themselves for better jobs now as a business of their own. Men who trained men, direct car men, formulate their business interests of all kinds, see life in themselves out of the rut, and establishing themselves, by taking M. S. A. S. training.

I Can Make You a Big Money Man Whether You Are Now a Mechanic or Not

Are you mechanically inclined? If so you can develop that aptitude and make a success in the automobile business. Not necessary as a mechanic but as a business man with a foundation of mechanical training so that you know how and can direct the work of others. This training will enable you to rise above the rank in a position of responsibility. Successful men are not born, they are made. Fore-sight planning training is what makes them.

Do you know that in one month of this year 404,000 new automobiles were built? Notice in every city, the automobile dealers have fine establishments. Automobile Row is the center of activity. The automobile dealer is the biggest man in this great business. Can you begin to imagine how great the need is for big men to lead the business of giving service to these cars? The opportunity is simply astounding. The industry has advanced so fast that enough trained men have not been developed to hold the big pay jobs.

I can fit you for one of these jobs and even to run a business of your own. To have a service station or be an automobile dealer. Our graduates are doing it now all over the U. S. A. and in many other countries. I can start you to success, as I have thou-

sands of other men. This School and its courses are endorsed by automobile manufacturers and service men.

Write to me today for full information. I want you to have a good job. I can qualify you quickly. Write to me today.

A. G. ZELLER

Michigan State Automobile School

Box 286, 3725 Woodward Ave., Detroit, Michigan

—Write a letter or see this response—

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Box 286, 3725 Woodward Ave., Detroit, Michigan

Tell me how I can become a big money man. My present work is

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St. R. F. D.

City

State

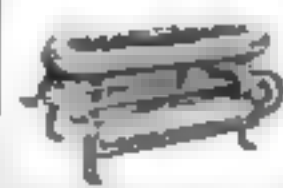
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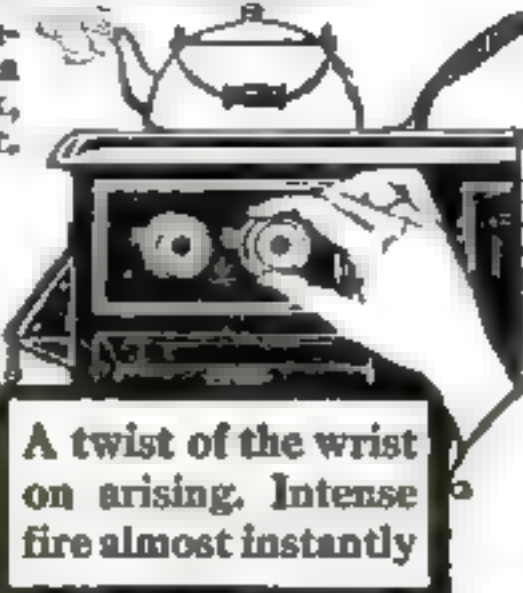
Science Says Use Nu-Gas To Cook and Heat

Up-to-date homes being built without coal bins because there's a better, cleaner, easier way to cook, bake and heat, by burning free air.

"Don't buy coal at present price," says a Domestic Science Expert. Don't buy it at any price. You can get far better results by burning free air and oil in the way science has recently discovered. The government does it, the big ships do it, factories do it, and new homes are being built without coal bins or wood-sheds because their owners have adopted the new, clean, dustless, dirtless, laborless device which fits in any stove.

Oil and Free Air Make Wonder Heat

Science has shown that one part of coal oil (kerosene) the cheapest of fuels, can be mixed with twenty parts of air (by a remarkable burner) and the result is a wonderful heating and cooking gas. Cheaper than city gas. No fire to build. Heats at twist of the wrist. Heats largest rooms in a few moments on easiest working. Heat given evenly for baking. No dirt, smell or soot. Saves work, saves furniture, saves health. And a new way has been found to cut useless parts, so that, of all burners, the NU HEAT (the latest one) is the best and lowest in price. It is sold as a job in your present range, heater furnace—then you are no longer a slave to coal and wood and the expense, labor and



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| 32x3 1/2 | 2.50 | .90 | 34x4 1/2 | 4.00 | 1.65 |
| 31x4 | 2.75 | .90 | 35x4 1/2 | 4.25 | 1.65 |
| 32x4 | 3.00 | 1.40 | 36x4 1/2 | 4.25 | 1.65 |
| 33x4 | 3.25 | 1.40 | 35x5 | 4.25 | 1.95 |
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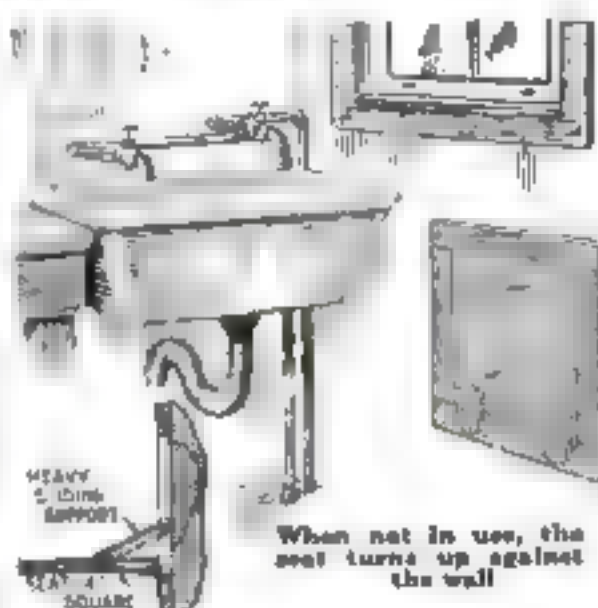
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Panel Seat Saves Steps in Small Kitchenette

IN SMALL kitchens or kitchenettes, where every foot of space is valuable, a panel seat made as illustrated is a useful addition. When not in use, the seat folds up flush against the wall. While it has nothing to recommend it in the way of



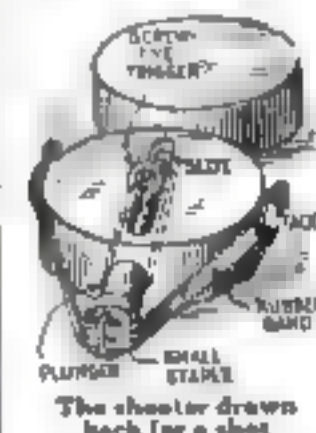
comfort, it does provide a handy rest for the housewife.

Chestnut or other hard wood 1 in. thick is used. The seat is fastened to the frame with two stout brass refrigerator hinges, and two very heavy sliding supports or stays hold the seat when down. A catch also can be added, although the seat illustrated remains up by tension and is opened by means of a small thumb notch in the upper member of the frame, not shown in the illustration.—A. G.

Carom Shooter Easily Made

THE simply made carom shooter illustrated is designed to save the fingertips. A checker or carom is drilled through horizontally to take a plunger made from a length of dowel or other small rod. A rubber band is tacked as shown, and held against the enlarged end of the plunger by a staple.

In operation, the shooter is held in place with the thumb and second finger, and the index finger is used to pull back the screw-eye trigger.—G.E.H.



Weaving Small Rubber Mats

USEFUL rubber mats can be made quite easily from 1-in. wide strips cut from old inner tubes. If some of the strips are red and others gray, interesting patterns may be arranged.

First tack down the lengthwise strips, stretching them slightly, and then weave the cross pieces. To fasten the ends, turn them in and weave back for about 8 in., pulling the ends snug and trimming neatly. Cementing the ends adds to the durability.—M. N. K.



1000 Things You Ought to Know

EVERY day in your work you get up against new problems. Sometimes it is only some old sticker coming in a new way. Just the same though it takes a lot of time to figure it out. DON'T DO IT. Here's everything worked out for you. Every problem big or little that you will meet in a day's work. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways you can make more out of the same work you are doing now.

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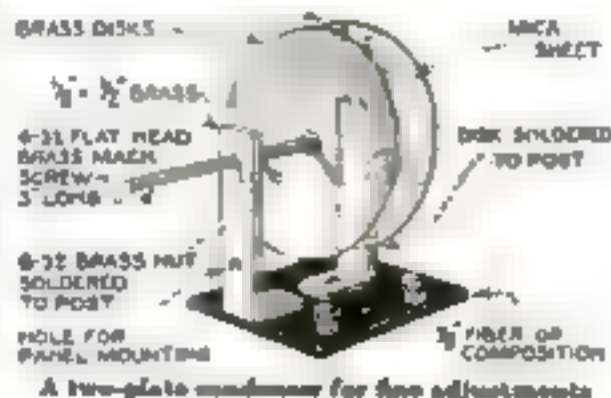
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Micrometer Variable Condenser Made for a Few Cents

FOR a few cents a radio fan can make a micrometer variable condenser that will give exceptionally sharp tuning in connection with a large condenser or used alone where critical adjustment of capacity is required in a hook-up.

The condenser plates are two brass or zinc disks. One is soldered to a brass support, as shown, and the other is soldered to the head of a 5/32 brass machine screw 3

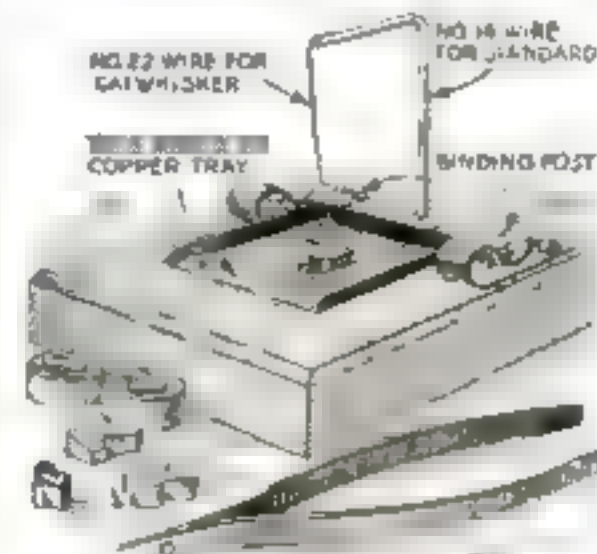


in. long. A 6/32 nut is soldered opposite a hole in another brass support and the machine screw turned into it. The two supports are then screwed to a 3/4-in. fiber or composition base. A thin piece of mica is shellacked to the stationary disk to prevent the plates from causing a short circuit.

Drill holes for the binding posts and solder a wire from each to one of the supports. A dial and knob are fastened to the machine screw, a brass shim being soldered to the screw, if necessary, to make them fit. Turning the knob moves the plates nearer or farther apart by very fine degrees.—**EDWIN G. GETTING, Los Angeles, Calif.**

Testing Radio Crystals Quickly

TO SAVE time in testing the relative merits of a number of mounted and unmounted radio crystals, I use the simple detector stand illustrated in place of the regular glass-covered detector on my set. Each crystal to be tested is placed on the



ALSO TO BE TESTED
The crystals are tested under catwalks

copper tray with the tweezers, pushed under the catwhisker, and manipulated until the surfaces have been thoroughly tried out. Either the signals of a broadcasting station or a buzzer can be used for the test.

The base is a block of wood $\frac{1}{2}$ by $2\frac{1}{2}$ by $2\frac{1}{4}$ in. A piece of thin copper or brass is bent up on three sides to form a tiny, shallow tray, fastened to the wood with escutcheon pins, and connected with one binding post. The catwhisker, with its end clipped to a sharp point, is mounted as shown and connected with the other post.—S. L. P.



**\$500
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In answer to a request from Chief of Police Warren Ingrow, the Fingerprint Expert arrived at the scene of the daring robbery of the O— Company office. \$6500.00 in currency was gone. Not a single clue had been found.

Almost immediately Biglow turned his attention to a chair which had been tipped up. The glazy mahogany showed an excellent set of finger prints. The thief might just as well have left his calling card.

To make a long story short, the prints were fingerprinted and matched with those of Big Joe Moran, a male hinner. Moran was caught and convicted on Higlow's finger print in 1914. The money was recovered and a \$500.00 reward given to Higlow, in addition to his one-way pay for his catchers work.

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No more fascinating work than this - and big rewards go to the **EXPERT** Thousands of men will be now needed. The finger print work of governments, corporations, police departments, detectives agencies, banks, individuals has created a new profession. Many men with \$1,000.00 to \$10,000.00 a year. And now you can easily learn the secrets of this new science in your spare time - at home. Any man with a common school education can become a **Finger Print Expert** in a short time.

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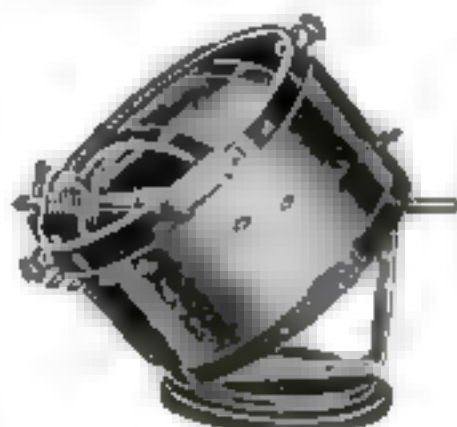
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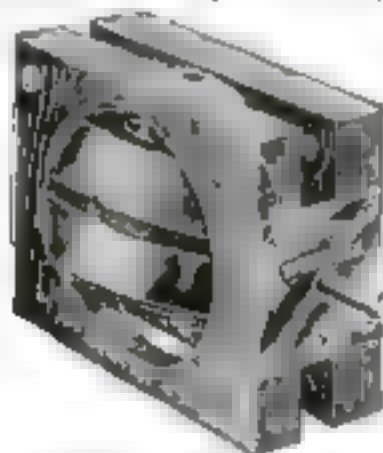
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Fountain Pen Ink Bottle Turned into Spirit Lamp

WHEN you have drained one of those handy filler-top desk bottles of fountain pen ink, the empty bottle can be converted into a spirit lamp for the workshop or laboratory.

Nick the glass filler with a file just where it starts to contract in size, and snap it off clean. Then cut off the rubber bulb, draw



A cheaply made alcohol burner

the glass tube out of the stopper and insert it from the other end with its flared end down. A piece of cotton wicking and a little denatured or wood alcohol make the lamp ready to use.

The flared lower end of the glass tube permits the wick to be drawn up as it is needed, by means of a pin. The sharp upper edge holds it from slipping back. The original metal screw cap acts as an extinguisher and keeps the alcohol from evaporating through the wick when not in use.—F. M. W., Jr.

Locked Barrel Is Useful for Storing Heavy Tools

ALTHOUGH heavy and large tools are almost invariably stored in the corner of the shop or barn because of the lack of a suitable box, this practice often results in loss or breakage.

A substantial and serviceable container for such tools is a tight coopered barrel, fitted with a reinforced cover, hinges, and a hasp. Such a storage place takes up little room and costs next to nothing, and the tools will always be found when wanted.

A locked barrel is a container of such large capacity that it is also useful for safeguarding other materials, such as harness, fuel, and oils.—L. A.



For large tools and bulky supplies

Making Shrink Fits

WHEN shrinking small parts together, it is not easy to obtain the precise fit necessary so that the outer part, when heated, will just slip over the inner. It is a matter of cut and try, plus care and experience. There is one little kink, however, that often has been found useful. If the fit has been made a trifle too close, so that the parts will not go together when the outer part is heated, it often will help matters to shrink the inner part slightly by putting it on ice until it is thoroughly chilled. When the two are assembled, there will be shrinkage from the outside and expansion from the inside. The work must be done quickly and there's some danger, if the outer part is not fairly substantial, that it will rupture from the pressure.—H. G.

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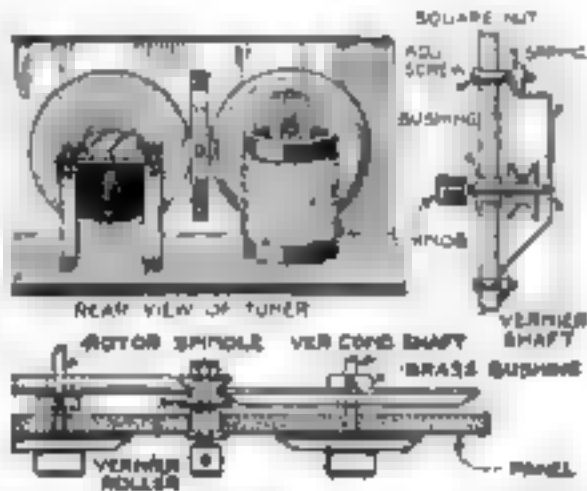
WRITE PLAIN



One Knob Provides Vernier for Two Radio Instruments

THE unusual feature of this Vernier control for a radio receiving set is that a single knob operates both the rotor of a variocoupler or variometer and a variable condenser. The operator makes fine adjustments of either without removing his hand from the knob, and this, of course, makes close tuning easier than if individual Verniers were used for the instruments.

Two disks of fiber or maple are turned, each with one beveled edge, and fixed to



Details of dual Vernier control. Note that the variocoupler and condenser are base mounted to allow room for the large disks.

the shafts, as shown, by set screws in their brass bushings. One beveled edge faces the front and the other the rear.

The roll is turned from fiber with two beveled surfaces facing each other. It is fixed to a floating shaft free to work in a brass bushing anchored in the panel. The pointed end of this shaft engages a hole in a bent-up flat spring, which is attached to the rear of the panel as shown.

The tension forces the beveled surface of the roll against the disk that has its beveled edge facing the rear and when the Vernier knob is turned, that disk moves. To turn the other disk, the knob is pushed in, thus forcing the roll in contact with the beveled edge of the second disk and out of contact with the first. This allows microscopic adjustments of both instruments to be made until precisely the correct tuning has been obtained.—C. M. WILCOX.

Waterproofing Shoes

SHOES can be made thoroughly waterproof at home by using any of the formulas given below. These have been



The sole is placed in grease that is warm but not hot for fifteen minutes.

tested by the U. S. Department of Agriculture.

Formula 1: Neutral wool grease, 8 oz.; dark petroleumum, 4 oz.; paraffin wax, 4 oz. Formula 2: Petroleumum, 1 lb.; beeswax, 2 oz. Formula 3: Petroleumum, 8 oz.; paraffin wax, 4 oz.; wool grease, 4 oz.; crude turpentine (from house) 2 oz. Formula 4: Tallow, 12 oz.; cod oil, 4 oz.

In each case the ingredients should be warmed and stirred until they have been thoroughly melted and mixed together.—E. A. HIGGINS, New York.

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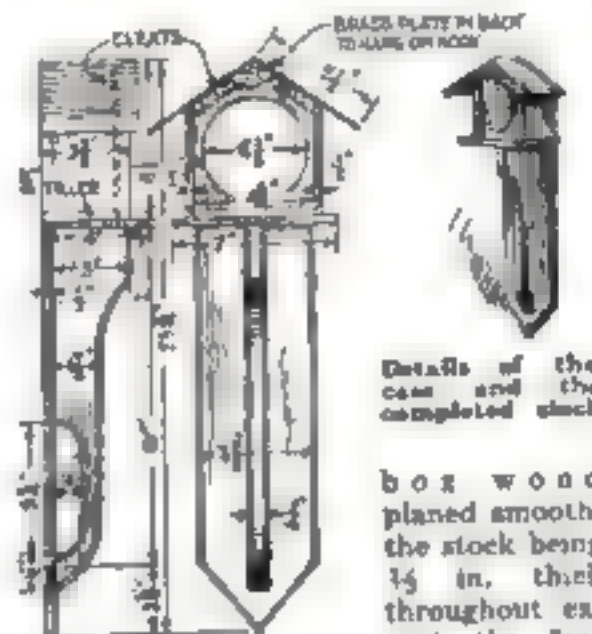
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Handy Wall Case Improves Cheap Alarm Clock

BY THE addition of the case illustrated, a common alarm clock can be used as a wall clock during the day and as an ordinary alarm clock at night. The case, if neatly made and carefully finished, converts even the cheapest alarm clock into a clock of attractive appearance.

I made the first of these cases for the shop, where an alarm clock kept on a shelf had been knocked down again and again. I have since made several others.

The cases were mostly built of packing-



box wood planed smooth, the stock being 1 1/2 in. thick throughout except the face

mat or frame, which is only 1/2 in. thick. The grain of this piece should run up and down and the circle be cut to suit the clock.

The gable in the case shown is at an angle of 30 degrees. A filler piece is required to raise the clock a trifle off the floor. I have a 1/2 in. block in my case at home, but have found 1/2-in. blocks better for other types of alarm clocks. The front frame is glued to this filler piece and it, in turn, is nailed to the bottom of the case.

A small piece of brass at the back holds the roof together and provides means for hanging the case up. The handle is 3/4 in. thick but can be made of 1/2-in. stock. The completed case is stained and varnished.

ERNEST I. C. ERLANDSON, Alameda, Calif.

Repairing Camera Bellows

ZIGZAG marks or patches sometimes found on films taken by amateur photographers are very often due to small holes in the bellows of a folding camera.

To locate such defects remove the back of the camera and hold it up to the sun, with the shutter closed and place a black



The minute holes are patched with adhesive tape.

cloth over your head to exclude the light. Cover the hole or holes when found with adhesive tape or plaster, preferably such as is used in medical work, and blacken the patch with India drawing ink applied with the filer quill or a small brush.—EDWARD H. FLAHERTY, Denver, Colo.

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How to Rebuild an Old Car

(Continued from page 114)

place it away and remove the body, having first dismantled all fenders, aprons, wiring, and other connections that might interfere with lifting it. Next, remove all tires and rims and then run the chassis out where you can take a paint brush with stiff bristles, a putty knife, and several gallons of kerosene to clean the exposed parts.

There is real fun in overhauling the bus, but no one likes to be dirty all the time. So clean it and have done with the road oil and general grime and dirt. The glisten of the aluminum crankcase alone repays you for the effort.

Now, I shall have to leave, but if you will get that chassis really clean before you go any farther, I will lay out a few jobs for you

1. Clean chassis.
2. Remove all units from the frame.
3. Inspect frame for cracks, loose rivets, and bends.
4. Renew all bushings in springs, if the old ones are badly worn.
5. Graphite all spring leaves after taking them apart and sanding them to remove rust. Reassemble springs.

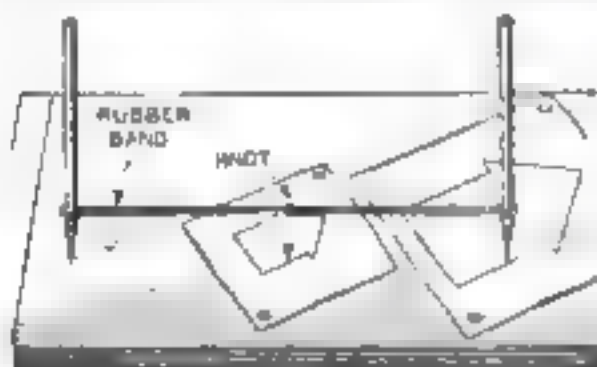
6. Rebrush the pivot pins and the tie rod yokes. Inspect and overhaul the front axle.

I will return next month to see how clean you have the chassis and whether you make a good job of the new bushings. Then we will take up the work of overhauling the rear end, the transmission and clutch, and, if we have time, the engine itself.

Enlarging Sketches with Rubber Band and Pencils

THERE are a number of ways of enlarging or reducing sketches, but the simplest method that I know is the one illustrated below. An ordinary rubber band and two pencils does the trick, or a rubber band, a lead pencil, and a pen.

Put a knot in the rubber band close to the center, as shown. If the knot is made exactly in the center, the enlargement will be twice the size of the original; by placing



The knot in the elastic is kept constantly over the line being copied by the right-hand pencil; the left-hand pencil remains stationary.

the knot one third of the distance, the enlargement will be 3 to 1; one fourth, 4 to 1.

The rubber band is placed around the pencils, and one pencil is held stationary while the other pencil is used for making the enlarged drawing. The direction and length of the line are regulated by watching the knot, which must be kept exactly on top of the line that is being copied.—W. F. SCHAFKORST, M. E.

TO AVOID bubbles in varnish, never shake a varnish can before pouring, and pour the varnish with the outlet uppermost.

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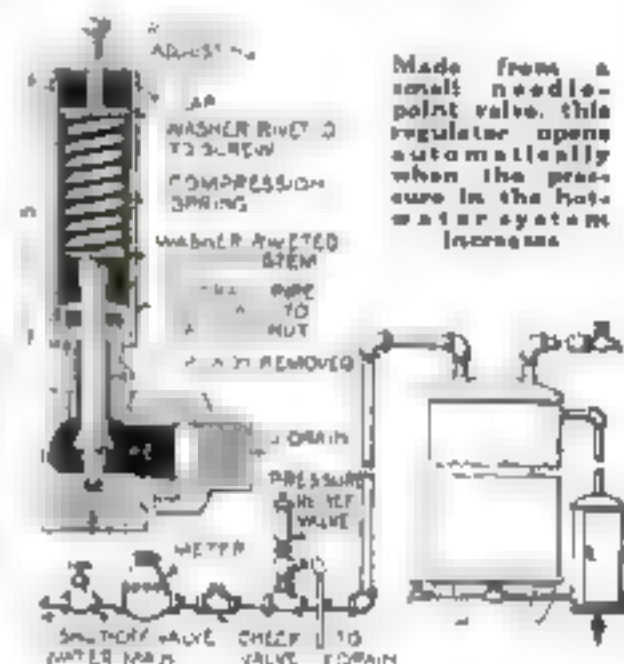
Huron and Kingsbury Streets, Chicago, Ill.

Hot-Water Relief Valves Prevent Waste and Leaks

By John H. Schalek

ASIDE from corrosion, the greatest annoyance experienced by the householder is that of leaking joints in the so-called "closed system" of water heating. In this system there usually is a check valve, which prevents the hot water's backing into the meter and damaging the hard rubber parts.

Because of the check valve, the accumulation of heat in the water at such times when little or no water is used, raises the pressure in the piping and tank to an alarming extent. An increase in water temperature from 80 to 100° F. may bring the pressure in a closed system up to 240 lbs. a square inch, assuming an initial water pressure of from 80 to 70 lbs. This is more than twice the pressure that the average hot water tank is designed to withstand. As soon as a faucet is opened, the pressure immediately drops to 80 or 70 lbs. Build-



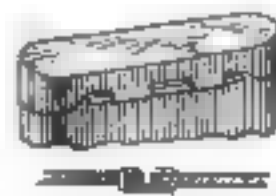
ing up and releasing this abnormal pressure several times each day cannot but have a damaging effect on the whole system and usually is the cause of leaks.

Fortunately, in many cases there are sufficient leaking faucets to act as a safety vent for this pressure. Only a few drops a minute are required to keep the pressure below the danger point. To release this pressure automatically, the device illustrated was developed from a needle-point valve having a 1/2-in. valve opening. The screw thread was filed off, allowing the stem to move up and down freely.

As soon as the pressure reaches a point beyond the counteracting pressure of the spring, the valve stem is lifted from its seat and the excess water discharged from the system. The amount of water is insignificant, but when the device is in use, the pressure in the water heating system may be kept almost as low as the city pressure.

Joining Sewing-Machine Belts

IN REPAIRING a broken sewing-machine belt, the home mechanic often has difficulty in finding a piece of soft wire the right size to bend into a connecting link. A length of No. 16 or No. 18 gage soft iron wire of exactly the proper size can be obtained by tearing off the cover of an old tobacco tin of the type shown and using the hinge pin.—W. B.



Gilded Picture Frames Made without Special Moldings

TO MAKE gilded picture frames without rabbeted molding or any expensive materials is not particularly difficult. The stock for the frames should be $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$ or $\frac{3}{4}$ in. thick and $2\frac{1}{2}$ in. wide for small sizes, and $\frac{1}{2}$ or $\frac{3}{4}$ in. thick and 3 or 4 in. wide for larger pictures.

Cut the angles not a true miter but a little less than 45 degrees, so that when the sides



The frame is painted with glue and barley, rice, or other grains are spread thickly over it.

are glued and nailed together, they will want inward a trifle. The slope should be noticeable but not too pronounced.

When the frame has been assembled, spread glue over its outer surface and outer edges, and while it is still wet, sprinkle rice over it to form an uneven and slightly wavy surface. When dry, this surface is gilded with metallic paint—gold, bronze, or

Mounting the picture on the glass (at right). The framed picture (below).



silver. If desired, the rice can be arranged by the use of a stencil to form an ornamental design, and the contrast between the various parts

can be heightened by using grains of various sizes.

If the picture is a printed one, moisten it on the back with water, spread it carefully on clean glass of the proper size, lap the waste edges over the glass and glue them in place. A photograph is mounted on cardboard and the cardboard is glued to the glass with strips of paper. An oil painting is mounted on cardboard and treated in the same way, but if on a stretcher, it can be fastened to the frame directly with brads.

"Junking" an Old Auto

YOU can often obtain more money for an old car if you "junk" it yourself than if you sell it intact to a junk dealer. Wreck the machine and separate the various kinds of metal. Sell the metal as scrap, and whatever is too bulky to get rid of in this way, dispose of to the junkman.

If you haven't time to do the job yourself, make a deal with some boy to do it for you.

In one case no dealer would offer the owner more than \$15 for the entire machine. Finally he "junked" the car himself and sold the metal and scrap for approximately \$60.—G. W. GREENE, New Bedford, Mass.



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Our Silent Partners

(Continued from page 118)

world over the animal one, we, as animals, can afford to ignore in the light of the havoc that we have worked on plant life for the purpose of agriculture.

Plants that survived the difficulties of escaping from the sea, that fitted themselves successfully into all the climatic vicissitudes of half a billion years, have yielded, at last, to the spirit of man. Man has made over, in large degree, the vegetation of the world. Some plants, such as the forest trees, he has removed bodily from millions of square miles. He has put other plants in their places, thereby because he happens to like them better or because he needs something that they produce. An obscure grass, for example, that grew sparsely on the mountains of Lebanon twenty or twenty-five thousand years ago now grows all over the world. It occupied nearly 100,000 square miles of the United States last year. The name of it is wheat.

Man Has Created Some Plants

This is man's doing, not Nature's. Who can say where it will stop? Man, as we said last month, has entered even into the realm of evolution. He has created plants that Nature never thought of. This may be, indeed, the solution of the pressing problem of human food.

Agriculture is not only the most ancient art, it is the art conducted most completely in the antique fashion. Plowing, for example, is still in all essentials, except labor, exactly as it was 6000 years ago. We know very little of the real chemistry of the soil or of the things, chemical and biological, that happen inside the bodies of growing plants. As the scientists learn more of these things, we may be able not only to induce two plants to grow where but one grew before, but to procure from one plant twice or three times or 10 times as much food as it is accustomed to yield. We have already done this for many grains and fruits. Compare, for instance, the wild apple and the cultivated one.

There is the possibility, too, that we may be able to duplicate artificially the process of photosynthesis by which plants use sunlight to make food, an enterprise upon which a committee of distinguished American scientists is now engaged. Success in this would make animals independent of plants for the first time.

It may happen so; it may not. We cannot foresee. But one thing we may be sure of: the problem of human food must be solved somehow. Life has overcome too many difficulties in the past to be dismayed in the end, by this.

Next month—Matter and Energy—
What atoms are and why they are the great potential source of power in the universe—How science is attempting to harness this power

FOR FURTHER READING

AMONG good books on plant life is "The Living Plant" by W. F. Fernald, Henry Holt and Co., New York, 1912. An excellent short account of the evolution of the plant kingdom is "The Evolution of Plants" by D. J. Seward, Henry Holt and Co., New York, Home University Library, 1912. The student who wishes to find an excellent summary of modern researches and many references to further literature in "Plant Physiology" by V. I. Parson, Second American Edition, edited by B. E. Livingston, J. P. Blackiston and Co., Philadelphia, 1912.

NOTE: The photograph of the ancient Babylonian tablet, published in the August, chapter of the series, should have been credited to the University Museum, University of Pennsylvania.



Carries Great Messages Around the World

THE statement is made that it is perhaps the greatest achievement of the modern age, the radio, which carries messages around the world in a single instant, but between all nations and all peoples of the world.

In the early days of the radio, the first great message was sent from the United States to Europe, and since that time the radio has become a powerful factor in the world's affairs.

The radio has become a powerful factor in the world's affairs, and it is now being used to carry messages around the world in a single instant.

Cunningham Radio Tubes

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Patent Notice: Cunningham Radio Tubes are covered by U.S. Patents 1,412,111; 1,412,112; 1,412,113; 1,412,114; 1,412,115; 1,412,116; 1,412,117; 1,412,118; 1,412,119; 1,412,120; 1,412,121; 1,412,122; 1,412,123; 1,412,124; 1,412,125; 1,412,126; 1,412,127; 1,412,128; 1,412,129; 1,412,130; 1,412,131; 1,412,132; 1,412,133; 1,412,134; 1,412,135; 1,412,136; 1,412,137; 1,412,138; 1,412,139; 1,412,140; 1,412,141; 1,412,142; 1,412,143; 1,412,144; 1,412,145; 1,412,146; 1,412,147; 1,412,148; 1,412,149; 1,412,150; 1,412,151; 1,412,152; 1,412,153; 1,412,154; 1,412,155; 1,412,156; 1,412,157; 1,412,158; 1,412,159; 1,412,160; 1,412,161; 1,412,162; 1,412,163; 1,412,164; 1,412,165; 1,412,166; 1,412,167; 1,412,168; 1,412,169; 1,412,170; 1,412,171; 1,412,172; 1,412,173; 1,412,174; 1,412,175; 1,412,176; 1,412,177; 1,412,178; 1,412,179; 1,412,180; 1,412,181; 1,412,182; 1,412,183; 1,412,184; 1,412,185; 1,412,186; 1,412,187; 1,412,188; 1,412,189; 1,412,190; 1,412,191; 1,412,192; 1,412,193; 1,412,194; 1,412,195; 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1,412,924; 1,412,925; 1,412,926; 1,412,927; 1,412,928; 1,412

Wreck survivors tell how tobacco kept them going

**When food and water gave out
on third day, they smoked
until rescued**

Perhaps they were only pirates of the sea. Nevertheless, they were very much human beings when they found themselves miles out to sea adrift in an open boat.

With two days' supply of food and water, they confidently expected to be rescued in plenty of time. But when the third day passed and no friendly sail appeared on the horizon, it began to look like a case for Davy Jones's locker.

One of the victims, crazy with thirst, suggested that they divide a bottle of iodine and end the agony quickly.

"The tobacco hasn't given out yet," said another. "Let's stick it out a while longer." And they did.

Late in the afternoon of the fifth day a tramp schooner saw their distress signals and came valantly to the rescue.

"The only thing that kept us going at all was tobacco," one of the survivors admitted when he was safely deposited on dry land again.

Pipes filled with Edgeworth probably have no more soothing effect than pipes filled with other tobaccos, but most Edgeworth smokers feel that they need Edgeworth to get complete pipe satisfaction.

If you have never smoked Edgworth, send your name and address on a post-



card to Larus & Brother Company. They will be glad to send you samples—generous samples both of Edgeworth Plug Shies and Roudy-Rubbed.

Smoke a few pipefuls and judge for yourself whether or not you wish to become a permanent member of the Edgeworth Club.

Edgeworth is sold in various sizes to suit the needs and means

of all purchasers. Both Edgeworth Plug Slice and Ready Rubbed are packed in small, pocket-size packages in handsome humiders holding a pound and also in several handy in-between sizes.

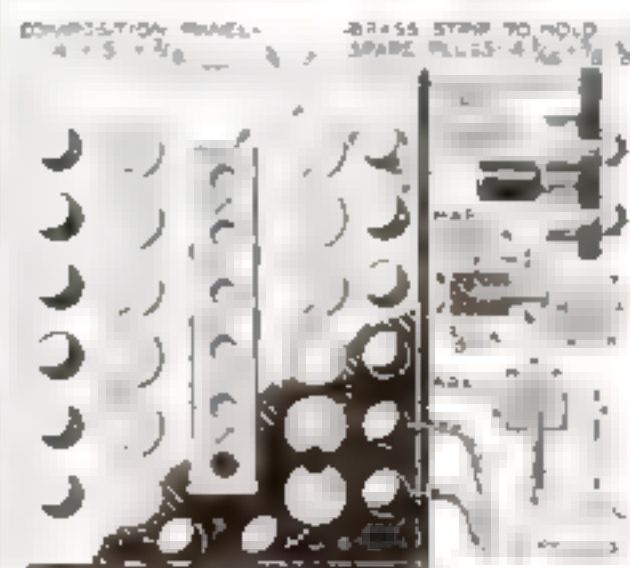
For the free samples, kindly address
Larus & Brother Company, 59 South 21st
Street, Richmond, Va. If you will also in-
clude on your postcard the name and ad-
dress of your regular tobacco dealer, your
courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Plug Switchblock Gives Easy Control of Radiophones

THE radio fan who prizes neat and unusually efficient apparatus will find the switchboard illustrated an excellent means for controlling the connections of his loudspeaker and telephone headsets. Five pairs of phones and a loudspeaker can be plugged in or out at will without changing any connections.

The base is a $\frac{3}{16}$ by 4 by 5 in. composition panel. The connectors are 12 pieces of $\frac{1}{8}$ -in. brass rod. The head of each is $\frac{5}{8}$ in. in diameter and $\frac{3}{8}$ in. deep, with a threaded stud or a separate stud provided, as shown, from a length of 10 32 threaded rod. It is just as well to mount these connectors first on a wooden templet the same size as the composition panel. Place the connectors so that there will be $\frac{3}{16}$ -in. clearance between the units of each pair, and $\frac{1}{8}$ or $\frac{1}{16}$



How the catchblock is laid out, and the wires and connectors are made

in. between the pairs. When the studs have been locked tight with nuts, drill $\frac{1}{2}$ -in. holes between and through the heads of each pair as shown. A piece of brass $\frac{1}{2}$ by $\frac{1}{2}$ by $\frac{1}{2}$ in. should also be drilled with the same size holes to hold the plugs when not in use.

The plugs should next be turned, as indicated, to be a snug yet not too tight fit in the $\frac{1}{4}$ -in. holes. A slight taper is desirable. Hard rubber handles about $\frac{1}{4}$ -in. in diameter and $\frac{1}{2}$ in. deep should be prepared for the plugs, but not fitted to them until they have been nickel plated and polished at a plater's or jeweler's.

While this is being done, use the wooden templet for marking and drilling the composition panel. Drill holes for the binding posts, bevel the edges, and give a satin finish with fine emery paper. The nickel-plated parts are then attached and the hard rubber handles fitted to the plugs.

The connections are made at the back, as shown by the dotted line, and the panel can be fastened to a hardwood block, recessed to take the projecting nuts and wires. The edges of the block should be notched

In use, the loudspeaker and telephone are connected with the various binding posts and the receiving set is connected with the terminal binding posts. To plug in the loudspeaker or any particular pair of phones, simply remove the plug from between the corresponding connectors and place it in the holder. **LESLIE GREENSTADT**, Hamilton, Ontario, 1 an.

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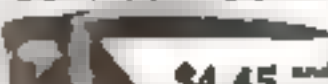
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EVERY sportsman occasionally wishes to test the accuracy of his rifle sights. In doing this easily and quickly, the gun rest illustrated is a distinct aid. It reduces the "human element" to a minimum, and, by using it for several shots, the grouping on the target will show up any marked deviation to right or left, or high or low.

The standard for the rest is a well-built sawhorse, the legs being mortised into the



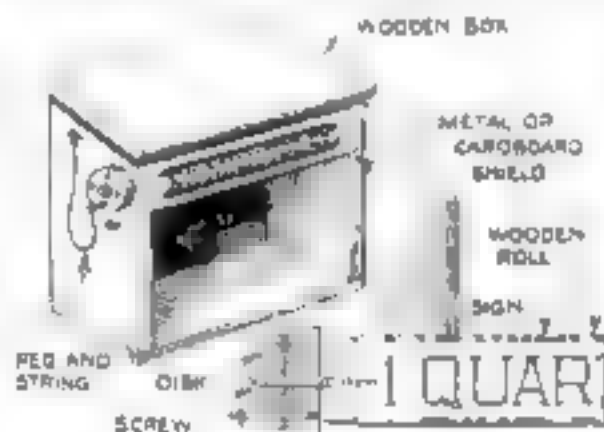
How the gun rest is made and used to adjust rifle sights accurately.

4 by 4 in. saddle at an angle. On the forward end of the horse an upright is dovetailed, so that it will slide as required, and at the same time be quite rigid. The upper end of the upright is notched to receive the gun barrel.

Just back of this upright an adjustable beam is hinged and into it is dovetailed a second upright, also notched to support the gun. Near the end of the horse is an adjusting screw for raising or lowering the hinged beam when sighting the rifle on the bull's eye.—LEROY W. HUTCHINS.

Changeable "Note" for Milkman

THE addition of a revolving indicator to a milk-bottle box makes it unnecessary to write notes to the milkman when extra quantities of milk and cream are desired. The wooden roll, made from an old curtain pole, is mounted so as to revolve easily near the top of the box. A wooden disk, about 3½ in. thick, cut from the same curtain pole, is fastened tightly to one of the pivot screws on the outside of the box.



A revolving indicator takes the place of scribbled orders.

Several holes are drilled through this disk, and one hole for indexing is drilled into the side of the box, so that a peg may be used to fasten the disk in any of its positions.

The roll itself is covered with a sheet of white paper on which the desired orders are lettered with waterproof drawing ink, one order corresponding to each index hole. A mat cut from galvanized iron, tin, or even cardboard is fastened to the box to serve as a frame for the roll. KARL L. MARTIN

Your "Greater Self" never Sleeps



DID you ever feel that you were being directed, at a crucial moment, in an important task, or when making a momentous decision, by some intelligence and power vastly greater than yourself?

Did your heart ever grow sick of the daily grind and the dull drab prospect of all the days and years ahead? And then did you experience an inspiring flash of thought, amounting almost to whispered words, that a higher, nobler and happier life was possible to you—that it was within your power to make your life anything you wanted it to be?

If either of these experiences ever came to you, did you wonder whence the inspiration came? It was your Greater Self whispering to you, and urging you on to become and achieve the things you wanted to become and achieve. You actually have a Greater Self. It occupies four-fifths of your brain. It never sleeps. It built your body from the beginning, and still sustains, repairs and renews it. It is your God Mind. It is timeless, and changeless,

and deathless, and abundantly able to give you every desire of your heart.

Although I am actively engaged in high judicial work, I have found time to prepare a personal manuscript message entitled "Realization," which has introduced a great many men and women to their Greater Selves, and since that introduction they have healed themselves of stubborn diseases, come into possession of the things they desired, succeeded abundantly in business and professional life, attained love and happiness, and, one by one, a calm peacefulness of mind which passes understanding. I will be glad to send you a copy of "REALIZATION" fully post paid and

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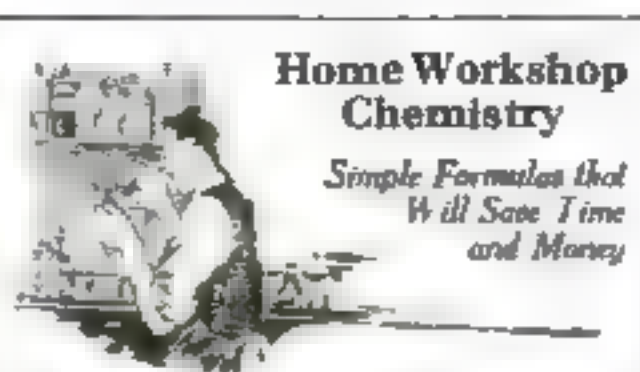
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Home Workshop Chemistry

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CEMENTS and glues can be used for the most diverse purposes in the home workshop. Some are water resistant, others fireproof, and others useful for joining either similar or dissimilar materials.

An effective cement for many substances can easily be made by soaking one part of glue in an equal quantity of water. The glue is removed before it has lost its primitive form, and the swollen mass is then dissolved in one part of linseed oil with the aid of heat until a jelly is formed. This joins wood tightly and is practically waterproof.

Finding that the continual reheating of glue is often troublesome, especially if small quantities only are required, I make a simple liquid glue. Although not as strong when dry as a glue especially prepared for a given piece of work, it serves the purpose about as well, especially for the small jobs that constantly require attention in every household.

One part of sugar is dissolved in three parts of water, and for each tablespoon of sugar used, 1/2 teaspoon of burnt or slaked lime is added. The solution is then slightly heated, not boiled, and, when cold, decanted from the sediment, which is thrown away. Dry carpenter's glue is dissolved in the liquid by putting in a few small pieces first and adding others until the glue has a syrupy consistency when cold. Should it become too thick, a little more of the sugar and lime water is added.

This is a fine glue for ordinary small jobs and suitable even for delicate inlays if gelatin is substituted for the carpenter's glue. It then becomes a transparent, colorless mucilage.

A glue that has received much attention lately, because it is widely used in aircraft work and automobile body construction, although a glue that even the ancient Egyptians used for their remarkably enduring cabinet work, consists largely of casein. Casein, which is nothing more than the curd of milk, can be obtained by slightly warming fresh milk to which a little acetic acid has been added. The precipitate is filtered through a cloth and washed. One part curds to four parts of water are stirred together until no lumps remain, a little ammonia is then added and the glue is placed in a pan of hot water and thoroughly stirred. It can be used cold like any mucilage.

A cement of glycerin and litharge is so hard that it can be removed only by being chopped out with a chisel. A pound of finely ground dry litharge is thoroughly stirred with 1 1/2 oz. glycerin, or in similar proportions. Use as soon as mixed, first rubbing a little viscous glycerin over the surface of the materials to be joined. The job must be finished within 15 minutes, as the mixture solidifies after 20 or 30 minutes.—ERNEST BADER, Ph.D.



Mixing glycerin
litharge cement

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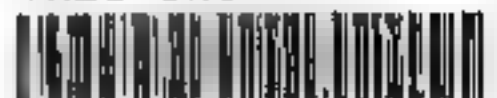
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This One



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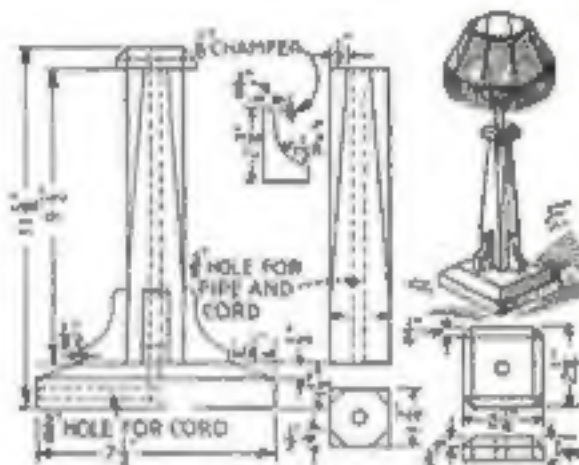
San Francisco

Craftsman Lamp for Library Table Is Easily Made

SIMPLE in design and not difficult to make, the oak lamp illustrated below is intended for use on a mission or "craftsman" library table. The shade may be of silk or parchment, or constructed of wood and stained glass in the home workshop. The lamp is proportioned for a two-light fixture.

The base is a 7½-in. square of 1¼-in. quartered oak, with a ½-in. hole bored through the center. Another ½-in. hole is bored, preferably with a doweling jig, from one edge of the base to meet the central hole. The base is then chamfered, the ends being finished first to avoid chipping and splintering.

The post is 1½ by 1½ by 9¼ in. The center of one end is found by drawing diag-



Working details of the lamp with dimensions suitable for a two-light fixture

onal lines between the corners, and a ½-in. hole is bored the entire length. The chamfers, which run out 2½ in. from the lower end, are then planed accurately.

The top is made by squaring a piece of ¾-in. oak to 2¼ in., sawing off the corners and chamfering the edges. It is bored with a ¾-in. hole. The four braces are cut from stock ¾ by 1½ by 2¼ in. The curve is cut on a band or jig saw, or with a coping saw, and the ½-in. chamfer planed as indicated.

All the parts should next be scraped and sandpapered. The post is fastened to the base by means of two No. 10 bright 2¼-in. wood screws, so placed as not to block the cord hole. The top is fastened to the post with glue and finishing nails, and the holes are plugged with stick shellac. The braces are glued in place.

Any method of finishing may be used. Usually it is best to match as nearly as possible the finish of the table on which the lamp is to stand. The wire and fixtures may be obtained in any electrical store and will be found very easy to install.—KENNETH R. LAVOY, Hudson, N. Y.



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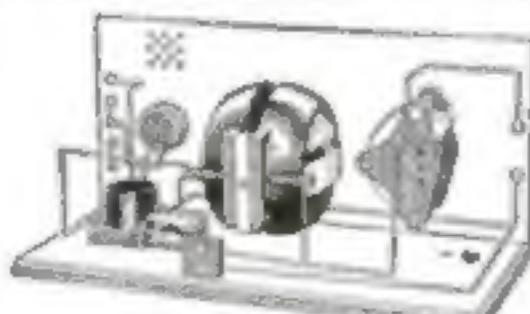
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